REPORT

TO THE GOVERNMENT OF CEYLON

ON THE

PEARL OYSTER FISHERIES

OF THE

GULF OF MANAAR,

BY

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WITH SUPPLEMENTARY REPORTS

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BY OTHER NATURALISTS.

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PREFACE.

When the last Part of this Report was issued, early in the present year, I still hoped that it would be possible to compress the remaining Supplementary Reports, along with the conclusion of the Pearl Oyster Report proper, within the limits of Part IV., and an intimation to that effect was made in the Preface. During the summer, however, when the Authors of the Supplementary Reports began to send in their manuscripts, it became plain that I had been too sanguine, and that a fifth and concluding Part would be necessary to finish the series. Under these circumstances I have decided to issue all the Supplementary Reports that are ready in the present Part—making it up to a volume of about the usual size of 300 pages and 30 plates—and to publish the few remaining Reports along with the several concluding sections of the Pearl-oyster work in Part V., early in 1906.

The Reports (all well advanced) which I still expect are:—On the Brachyura, by Mr. Douglas Laurie; on the Schizopoda and Stomatopoda, by Mr. Walter Tattersall; on the Anomura, and on the Actiniaria; on the Marine Insects, by Professor G. Carpenter; on the Tunicata, by myself; a list of the Molluscan Shells, by Mr. R. Standen and Mr. A. Leicester; and a list of the Foraminifera, by Mr. W. J. Dakin. There will be a further, and final, instalment on the Parasites of the Pearl Oyster, by Mr. Shipley and Mr. Hornell, and I propose to add a general discussion of the faunistic results. These sections, with the remainder of the Pearl-oyster work, and the Summary of Results and Recommendations as to the Conservation of the Banks, should then complete the Report.

The valuable memoirs in the present volume will speak for themselves, but I desire to express here my very cordial thanks to my friends the various contributors for their kindness in undertaking the work, and for their skill in carrying it out. The only case that calls for any further remark is the last in the volume. In order to prevent delay, I arranged with Dr. Willey that the proofs of the Report on the Polychæta should not be sent out to Ceylon. As the "copy" was supplied to me in the form of a corrected print marked "for press," and as Mr. Arnold Watson and Mr. Cyril Crossland—both familiar with the group—have kindly helped me to read the proofs, I hope that the chance of errors having escaped notice has been minimised. I have added at the last moment an interesting note by Mr. Arnold Watson on the Polychæte worm which is commensal with the sponge *Aulospongus*

tubulatus—a familiar object on the pearl banks. This worm, when first found, was supposed to be an Oligochæte, but now proves, as Mr. WATSON has shown, to be a Polychæte allied to the *Leucodore* that burrows in the pearl oyster shells.

During the present year, since the issue of Part III., important changes have taken place in Ceylon, both on the pearl banks and in the arrangements proposed for future fisheries. The recommendations made, on biological grounds, in the article on 'The Present Condition of the Pearl Banks' (Part III., p. 44) were not fully adopted by the Government of Ceylon.

The South Cheval Paar, which it was hoped would be left for another year, to supply a fishery in 1906, was stripped along with the Modragam Paars and some other sections of the Cheval—the result being that the great fishery in the Spring of 1905 now holds the record both for the total number of oysters fished and also for the amount of revenue brought in to the Government. The prices obtained were very high, and it is, of course, under such circumstances, a great temptation to a Government to fish and sell as many oysters as it is possible to obtain in the limited time permitted by the weather. It must always be a difficult matter to decide whether oysters present in abundance but admittedly immature should be secured at once or left to have an additional year of growth and probable pearl-formation. We can only hope that on the present occasion the decision has been a wise one, and that the clearing of the South Cheval Paar has not imperilled the success of next year's fishery.

Another factor which may have an important bearing upon the future history of the Ceylon Pearl Fisheries is the proposal that the pearl banks should be leased for a period of years to a Syndicate, which will be bound by the terms of the lease to expend a considerable sum annually in the cultivation and exploitation of the fishing grounds. It seems probable at the time of issuing this volume that the next Ceylon Pearl Fishery will be held under the auspices of the Syndicate.

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THE UNIVERSITY, LIVERPOOL.
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REPORT ON THE PEARL OYSTER FISHERIES OF THE GULF OF MANAAR.—PART IV.

THE GREAT PEARL FISHERY OF 1905.

(Drawn up from the Government Official Reports and Mr. Hornell's Letters, with Additions and Remarks.)

The Pearl Fishery which was held at Ceylon in the spring of 1905 may well be called "the great fishery." The temporary "fishery-town" erected at Marichchukaddi was larger than it is known to have ever been before, the inhabitants congregated there were at least 10,000 more than in the previous "record" fishery of 1904, the numbers of divers (4991) and their attendant mandacks (4894) and the fleet of boats (318) were much greater, and the totals of oysters fished and of rupees obtained for the Government were far beyond all previous records. There were forty-seven fishing days as against thirty-three in 1904. The number of oysters collected (upwards of eighty-one and a half millions) is nearly double that obtained at any previous fishery, and the revenue derived from the Government share alone was nearly two and a half million rupees, which beats all other known fisheries with nearly 15 lacs of rupees to spare.

This is the last of a series of three highly successful fisheries in consecutive years, and it does not seem likely to be rivalled by any prospective fishery of the oysters now in sight upon the grounds. The fishery of 1903 yielded 41,180,137 oysters and the Government share of the revenue was about £55,303; in 1904 the oysters totalled 41,039,085 and the Government revenue £71,050; in 1905 the number of oysters was 81,580,716 and the revenue over £167,381. From these fisheries, taken together, the Government of Ceylon has derived fully £293,735, without taking into account the revenue derived from postal returns (which at these three fisheries were considerable), and other receipts indirectly connected with, but consequent upon, the industry.

These figures look magnificent, and they show what a valuable possession the

Ceylon Government has in the pearl banks, but it must be remembered that this series of three very profitable fisheries followed on an interval of eleven years during which there were no returns, and that the average yield for the last three years is far above that of the last hundred or so—the period for which we have any accurate record.

It may be of interest to quote here the results of the chief fisheries of that century:—

(1.)	1905	yielded	81,580,716	oysters.	Revenue	= 2,510,727 Rs.
(2.)	1904	,,	41,039,085	,,	,,	= 1,065,751 ,,
(3.)	1814		*		,,	= 1,051,876 ,,
(4.)	1891	,,	44,311,441	,,	,,	= 963,748 ,,
(5.)	1808		*		,,	= 842,577 ,,
(6.)	1903	,,	41,180,137	,,	,,	= 829,548 ,,
(7.)	1888	,,	22,052,769	,,	,,	= 804,247 ,,

* Particulars as to number of oysters fished not available previous to 1835.

After that the revenue rapidly drops to seven, five, four, three, and two hundred-thousand rupees, and there are a number of fisheries on the list with between one and two hundred-thousand. As an example of a very poor fishery, we may take the one held in 1884 off Chilaw, yielding only 636,000 oysters and a revenue of 17,153 rupees. Many single days in the recent fishery far exceed the entire proceeds of certain previous fisheries.

The Report of Mr. G. P. Lewis, Government Agent, writing as Superintendent of the fishery, puts in this way "the extraordinary achievements of this fishery by comparison with the chief fisheries of former years, the fisheries of 1808 and 1903 were beaten in ten days, that of 1891 in eleven, and those of 1904 and 1814, which had hitherto occupied the first and second places respectively, in twelve." The fishery lasted for 35 days after that. Mr. Hornell, in his Report, puts it another way, and says that the total number fished "all but equals the combined totals of the two great fisheries of 1903 and 1904, and is not far from double the highest number taken in any other fishery concerning which we have authentic information, namely, 44,311,441 in 1891" ('Ceylon Sessional Papers,' 1905, p. 36).

Enough has been said to show the exceptional nature of the recent fishery, but it is quite a pertinent question whether this phenomenal success has not been attained, to some extent at least, at the expense of the next few years. It will be remembered that in the section of this Report entitled 'Present Condition of the Pearl Banks' (Part III., p. 37), written a year ago as the result of Mr. Hornell's inspection in November, 1904, certain reasons were given for fishing in 1905 the two Modragams and the sections of the Cheval defined as south-west, mid-east, and south-central (see fig. 1), leaving for 1906 the sixty-odd million oysters upon the South and South-

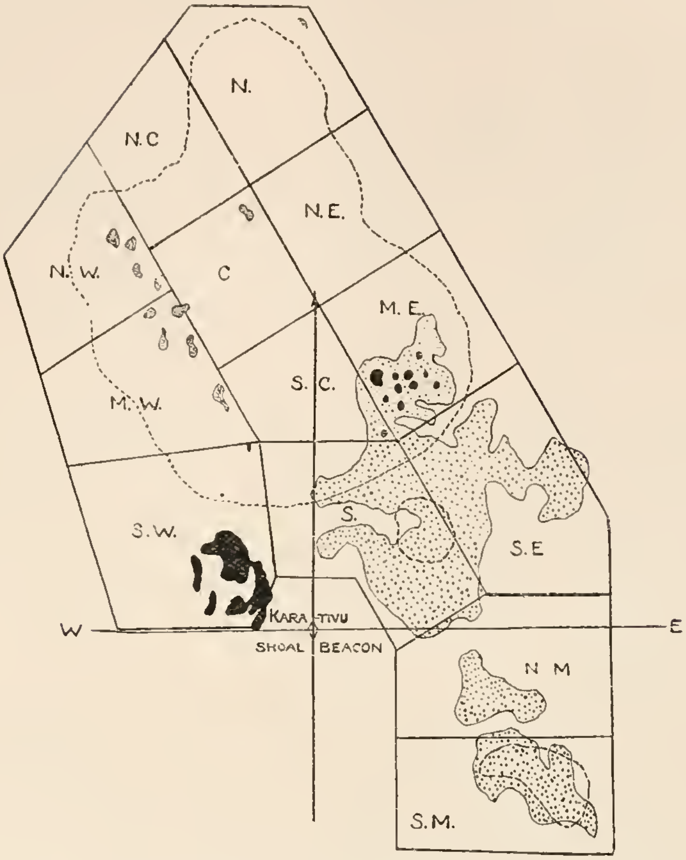

Fig. 1. Sketch-plan of the Cheval and Modragam paars, showing the distribution of pearl oysters in November, 1904. Scale: Half an inch to one nautical mile. The broken line surrounds the areas covered with spat a few months old, the dotted areas are those with oysters about 3 years old, the solid black indicates those beds of oysters over 5 years old.

east Cheval. The oysters on the banks in question were then estimated to be as follows:—

Paar.	Number of oysters.	Age in March, 1905.
South Modragam	21,000,000	Over 3 years.
North Modragam	4,700,000	,, 3 ,,
South-west Cheval	3,500,000	,, 5 ,,
Mid-east and South-central Cheval	13,750,000	3 to 6 ,,
South Cheval	40,220,000	Over 3 ,,
South-east Cheval	23,600,000	,, 3 ,,

Of these, the oysters on the two Modragam paars were thought to be unhealthy and liable to die off; those on the South-west Cheval were very old and clearly had to be secured at once or not at all; and those on the Mid-east and South-central Cheval were apparently being smothered by young oysters. Consequently the recommendation was that these forty-three million oysters should be fished first,

leaving the rest which seemed healthy, vigorous, and safe for a further year of growth and pearl-production.

On the other hand, the November valuation of the pearls from the samples collected gave 24.65 Rs. per thousand to the South Cheval, as against 17.86 Rs. for the South Modragam which stood next. That fact was sure to cause pressure to be brought by the pearl merchants upon the Government in favour of fishing the South Cheval; and it is, of course, impossible to avoid sympathising with the view that 40 million oysters in the hand may be worth a good deal more than the chance of getting them next year at an enhanced value. Our recommendation of last year accordingly ended with these words:—"On the other hand, there is, of course, always a certain risk in leaving a fishable bed of oysters unfished, and, once the biological facts given above have been stated, it lies with the Government to decide what risk can be run and what course should be taken. If the 40,000,000 oysters on the South Cheval Paar, or a considerable number of them, can be fished in addition to the 43,000,000 which certainly ought to be secured first, there will, no doubt, be a large additional profit now—a present certainty in place of the prospect of a possibly much greater result next year" (Part III., p. 46).

The 'Gazette' of 16th December, 1904, gave notice, however, that the fishery, to begin on 20th February, 1905, would include the South Cheval, the South-west Cheval, the Mid-east Cheval, and the North and South Modragams. We can now only hope that the decision of Government to fish the South Cheval in 1905, in addition to the beds we had recommended, was a wise one, and that it has not too seriously affected the fishery prospects of the next few years. It is to be feared that the oysters fished from the South Cheval will scarcely maintain in pearl-yield the reputation of their bank, and it can scarcely be doubted that, had they been left, and had they survived, their value next year would have been much greater.

The inspection in February, immediately before the fishery, showed fortunately that no catastrophic change had taken place. The numbers for the South Cheval and North Modragam were increased, those for the Mid-east Cheval and South Modragam were reduced somewhat, while the very old oysters on the South-west Cheval, as was to be expected, had continued to dwindle and were now so few and so scattered as to be scarcely fishable.

The most noteworthy observation in this inspection was, as Mr. HORNELL states, that on the south-east side of the South Modragam "the bed extended beyond the limit of the ground inspected, and there was therefore a probability that the actual numbers would prove considerably in excess of the estimate." I discuss this particular bed of oysters further on (see below, p. xi.).

The following statement of the numbers* estimated at the November and February inspections, and the actual numbers fished from the beds, may be worth recording:—

* The numbers recorded by Mr. LEWIS and by Mr. HORNELL respectively in their reports differ somewhat in detail on account of the methods adopted in assigning the oysters to their banks.

Paar.	November.	February.	Fished.
South Cheval	40,220,000	47,500,000	29,383,444
Adjacent part of South-east	—		1,503,590
Mid-east and South-central Cheval	13,750,000	9,000,000	2,975,849
North Modragam	4,700,000	10,000,000	7,280,817
South Modragam	21,000,000	19,700,000	Say, 10,000,000
Kutiramalai	Not estimated.	Not estimated.	„ 30,732,820
			81,876,520

Mr. Hornell estimates that about forty-one and a half millions of adult oysters are left on the banks. It is to be feared that a considerable number of these will die off during the year, but a solid bed of 10,000,000 remains on the South-east Cheval, and will probably be available for fishing next spring. There may be other patches on other parts of the Cheval still remaining in sufficient numbers to be worth fishing, and there ought to be a good many left on the South Modragam and the Kutiramalai paars, but these are said to be largely overgrown with a younger generation, and it is quite doubtful whether a sufficient number of the old will survive to yield a fishery in 1906 on these banks.

I now come to a question connected with the large number of oysters recorded in Mr. Lewis's report as fished from the South Modragam Paar, upon which I wish to make some observations. I shall quote first a couple of passages I find in Mr. Hornell's report (p. 38) in regard to the finding and fishing of these oysters :—

"34. On 22nd February a considerable number of boats fished on the ground to the south of that portion of the South Modragam inspected earlier in the month. The whole of this area is composed of purely sandy bottom, whereon lay oysters free from commingling with any of a younger generation ; all were a little over three years old. In some places they lay in loose bunches ranging from five to twelve individuals in each ; elsewhere the oysters clung to the projecting edges of large wedge-shaped shells of *Pinna bicolor*, rooted upright in the sand by the narrow end. The former condition delighted the hearts of the divers ; the latter gave those unprovided with protecting finger-stalls considerable trouble, the sharp edges of the Pinna shells inflicting frequent cuts and scratches on the hands tearing them from their sandy foothold. In both cases the divers filled their bags with remarkable celerity, 40 seconds in many cases sufficing to fill the diver's bag with 60, 70, or even 100 oysters. As a result, the day's catch, aggregating the enormous total of 4,574,460 oysters, broke every known record."

* * * * * *

"35. Work, on this sandy area, continued with feverish activity for the remainder of the week. The daily catches never fell below 4,000,000 per day, while on 24th February high-water mark was reached with the enormous take of 5,005,685 oysters.

Such a large total for one day's fishing establishes a record that is likely to remain unsurpassed for many years to come."

It is exceedingly interesting to find thus, from the official reports, that a considerable number of the oysters (from twenty-seven to thirty millions) credited (in the report of the Superintendent, p. 2) to the South Modragam Paar were really fished from an area extending to the south-east far beyond the usual limit of that paar. We must either conclude that the oysters have extended over the sandy ground lying between the South Modragam Paar and Kutiramalai point or that a new bed of oysters in this position has been fished. The difference may be considered to be unimportant, as being little more than a point in nomenclature. I notice that Mr. LEWIS in his report prefers to regard the whole of the large irregular-shaped area as being the South Modragam Paar; while Mr. HORNELL gives to this new southern part a new and quite appropriate name, "Kutiramalai Paar," on the analogy of Aripu Paar, Vankali Paar, Karativo Paar, Chilaw Paar, and others—all named after the land off which they lie. I think the latter course is the better simply because it does less violence to our existing ideas, charts and definitions. I reproduce here (fig. 2) a tracing from Captain DONNAN'S chart with which I worked when on the pearl banks in 1902. It shows the North and South Modragams as two little areas of approximately equal size, and the South is certainly nothing like, either in shape or position, the area from which, judging from Mr. HORNELL'S sketch-plan given as "Annexure I" on p. 49 of his report (Colombo, 1905), the oysters in question were obtained. In the definitions of these paars which I gave in the first volume of this Report I find that the North Modragam is described (Part I., 1903, p. 105) as lying "south-east of the central part of the Cheval Paar, at from $\frac{1}{2}$ mile to 1 mile distant, and is nearly 1 mile in diameter. It is about $8\frac{1}{2}$ miles west of Kallar tower. The depth is from $5\frac{3}{4}$ to $6\frac{3}{4}$ fathoms," &c. The description of the South Modragam runs (*loc. cit.*, p. 106): "This lies 1 mile south-south-east of the North Modragam, and is about $\frac{1}{2}$ to $\frac{3}{4}$ mile in diameter. It is about 7 miles north-north-west of Kodramallai Point, and has a depth of $5\frac{1}{2}$ to 6 fathoms. The bottom is rocky," &c. All this agrees with Captain DONNAN'S chart and, I think, with previous records of these paars, but not with the area from which the thirty million oysters were fished this year, as shown in Mr. HORNELL'S sketch-plan which I here reproduce (fig. 3) for comparison with fig. 2. Consequently I would favour the application of the new name "Kutiramalai Paar" to this very considerable southerly extension of the area hitherto known as the South Modragam Paar. It has this year proved itself to be of very much greater importance than many paars which have for long enjoyed distinctive names.

Now to turn to a more interesting point than mere nomenclature. Have these oysters on the Kutiramalai Paar, which had apparently not been inspected and estimated last year, but which have been fished this year along with those of the South Modragam, ever been seen before? *I believe they have,* and that I found them myself in March, 1902, when dredging along with Sir WILLIAM TWYNAM,

Captain DONNAN, and Mr. HORNELL, in the "Lady Havelock." When I read of these oysters in the Reports of Mr. LEWIS and Mr. HORNELL, I at once recollected

Fig. 2. Captain DONNAN'S outlines and positions of the Modragams (N.M. and S.M.) and Cheval Paar (Ch.) in relation to Kutiramalai Point (K.P.), the Shoal Buoy (S.B.). The positions of the dredgings made from the "Lady Havelock" on March 17th, 1902, are shown by the four crosses lying to the south-east of the South Modragam. Scale one-fourth of an inch to the nautical mile.

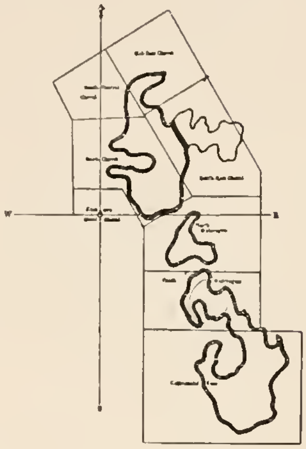

Fig. 3. Mr. HORNELL'S sketch-plan of the fishing ground of 1905, reduced to the same scale as fig. 2, one-fourth of an inch to the nautical mile. The thick lines show the areas fished, the thin line in the South-east Cheval the area with oysters over three years old left unfished, and the dotted line in the South Modragam the ground occupied by oysters six months old. Below that is the large area which Mr. HORNELL has called the "Kutiramalai Paar."

the occasion, and on turning to my notes I find (see this Report, Part I., 'Narrative,' p. 84, published in 1903) :—

"After rejoining Captain DONNAN and the inspection boats in the South Cheval district, we took four hauls of the dredge between the South Modragam Paar and Kodramallai Point. These may be united as Station LXIV. From between South Modragam and Jaggerboom Paars, along a line south-east towards Kodramallai Point; depth $4\frac{1}{2}$ to $5\frac{1}{2}$ fathoms; bottom coarse sand, with much fine green weed and small pearl oysters."

* * * * * *

"The fine green weed from the bottom had very young spat of pearl oysters on it. The small oysters dredged were 8 or 9 months old, and were in quantity at about $3\frac{1}{2}$ miles off Kodramallai Point." I had brought Sir W. TWYNAM from Jaffna that

same morning (March 17th, 1902) and wished to show him how the dredge could bring up oysters or whatever else lay on the bottom, and I believe that these first dredged young oysters that we showed him "between South Modragam Paar and Kodramallai Point" were a sample of the oysters which have been fished this year from the "Kutiramalai Paar," and have contributed much to the success of the present fishery. The age of the oysters agrees, and the position on the chart is about right. The four little crosses on fig. 2 show the four dredgings united in the 'Narrative' as Station LXIV.

Finally, I would make a general remark upon paar-ground in the Gulf of Manaar. It is, that we need never be surprised to find that boundaries of banks alter, and that oysters appear on occasions in new spots. I have already pointed out in a previous part of this Report that the whole of the shallow shelf within, say, the 12-fathom line is potential paar-ground. The bottoms shift to some extent and may change their character, sand may be washed over a paar, or again may be swept away, leaving a hard bottom. One of my first observations when dredging on the "Lady Havelock" was that we found oysters in the Cheval district where they had no right to be, according to Captain Donnan's outline of the paar. This statement may seem to cut at the root of my own charts and definitions; but it is not really so. The outlines of the paars are justifiable and, in fact, necessary as representing the normal, departures from which may be expected, but are exceptional.

It is evident that there is some difference of opinion amongst the authorities in Ceylon as to whether or not "dredging is economically a more sound method of fishing than is diving." I am inclined to think that the operation has not yet had a fair trial; but even though it may not, under the conditions in vogue in the East, be able to compete economically with native diving, I must emphasise what I have said elsewhere in this report, that the utility of dredging is by no means confined to obtaining a supply of adult oysters for the market, but is really fourfold, consisting as it does:—

(*a*) In fishing oysters;
(*b*) In cleaning the ground and removing enemies;
(*c*) In thinning out overcrowded beds; and
(*d*) In spat transplantation.

Its value is not properly assessed if account be taken of the first of these alone, or even of the first and the last. Finally, it must be remembered that several of these important operations can usually be carried on in the same series of dredgings.

Mr. Hornell is acting in accordance with these views, and at the recent fishery it is evident that a good deal of transplanting, cleaning, and thinning out went on simultaneously with the fishing for oysters. I shall quote a few sentences in regard to this work in Mr. Hornell's own words:—

"90. On 15th March enough of mature oysters had been removed by the divers

from the central portion of the South Cheval to permit of the commencement of operations for the establishment there by transplantation of a bed of young ones. Accordingly, I instructed Captain Jelstrup to dredge for young oysters aged about six to seven months, which I knew to be in profusion in the South Modragam Paar, to convey them to the South Cheval and there to throw them overboard within the limits which I defined by a series of mark buoys.

"91. The method adopted was to bag all the young oysters taken, to keep them in a cool place covered with wet sacks, and to steam twice a day, noon and evening, to the South Cheval, throwing them out as the vessel manœuvred between the flags. The young oysters stood the treatment well; there was practically no mortality, as I ascertained by sending divers down from time to time to ascertain the condition of these young, and to bring me samples.

"92. The total quantity transplanted was upward of ten millions. I propose to concentrate attention upon this bed during the next season, in order to give the experiment fair treatment. I hope to transplant thereto in November next an additional 10 to 15 millions; after that we may hope that enough work shall have been accomplished to ensure a small fishery two years later—a result that would be due entirely to cultural methods, and not to the fortuitous interaction of currents and other natural influences.

"93. During the course of the dredging, a great amount of good was done by the capture and destruction of large numbers of starfishes and carnivorous gastropod molluscs, noted enemies of the pearl oyster. Frequently between 200 and 300 starfishes were taken and destroyed in one day. By my instructions these were retained on board for twenty-four hours in order to insure that life should of a certainty be extinct, when they were returned to the sea."

In regard to the bed of young transplanted oysters, Mr. Hornell adds:—

"109. Prior to leaving the banks, I directed the Government divers to examine the area in question. They reported young oysters apparently numerous, the individuals they brought up were in good health, exhibiting no ill-effects consequent on the transplanting operation. Some had attached to fragments of cultch rubble laid out during the course of the fishery.

"110. (*b*) *Thinning out.*—This operation went on concurrently with transplantation, the abundance of young oysters on the South Modragam being so inordinate as to constitute, through overcrowding, a grave danger to their own continued prosperity. Transplantation, by entailing a reduction in the numbers upon the South Modragam, should re-act favourably, and if the density of population be found still too great when next the bed is inspected, further transplantation should be resorted to. So great is the present profusion, that the numbers taken in the dredges upon the last day appeared as great as on the day transplantation was begun, and indicated no appreciable diminution in the fertility of the bed.

"111. (*c*) *Cultching.*—During the fishery a quantity of rubble obtained from the

indurated limestone strata of Kayts, near Jaffna, was laid down, principally upon the sandy portion of the South-central Cheval, a region which has never yet yielded a pearl fishery. The quantity contracted for was 180 cubes; unfortunately the contractor experienced such difficulties in obtaining vessels to convey the stone to its destination that he was able to deliver less than half the specified quantity, although I helped him materially by extending the time limit by a week.

"112. The stone, on the whole, was satisfactory in quality, and likely to prove a durable cultch material. In size the blocks approximated $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by $2\frac{1}{2}$ in., but several consignments contained a proportion of blocks of excessive dimensions, and these I rejected.

"113. The total amount laid down was just under 300 tons. Some 40 tons of the friable semi-calcareous sandstone of Kalpitiya was also used. The greater part was deposited on the South-central Cheval, some 20 tons on a sandy patch near the centre of the South Cheval, and about the same quantity on the north-east quarter of the South Modragam Paar, a locality where there is no outcropping rock on the bottom. Several times towards the end of the fishery I received fragments of this cultch from the divers with young oysters attached to the surface."

This fishery was phenomenal not only in the number of oysters obtained, but also in the prices that they fetched. While the valuation of the samples taken at the November and February inspections showed a range of from 8 to 24·65 rupees per 1000, the oysters at the fishery sold at very much higher prices—the lowest being 24 and the highest 124 rupees per 1000. The average price over the whole fishery was 48·89 rupees. Of these oysters sold by the Government, Mr. Lewis states that "India took a hundred times the quantity taken by Ceylon." It is to be hoped that India will not be sorry that it took them. Judging from the probable pearl-yield of these oysters, it is difficult to see how the business can be made to pay at such inflated prices. However, the Bombay pearl merchants, Kilakarai Moormen and Paumben Chetties probably know best what they are about, and the mysteries of the Indian pearl market may justify even more remarkable proceedings than the paying of 124 rupees for oysters valued by the experts at 12·70, 27·41, and 31·10 rupees per 1000.

REPORT

ON THE

ISOPODA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

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[WITH TWELVE PLATES.]

THE interest of the present collection is not to be measured by the number of species or the number of specimens, still less by the size of the animals. The species are not numerous, the examples in many cases are few, and of some the dimensions have proved to be afflictingly small. On the other hand, there is no want of variety, since the thirty-four species more or less definitely discriminated are spread over five very distinct tribes and divided among sixteen families. There is no want of novelty, since two of the families, three of the genera, and fourteen of the species are now added to science on what appear to be satisfactory grounds. Certainly the family AMESOPODIDÆ, founded on some small creatures allied to *Idotea*, must be thought well worthy of notice.

The only family illustrated by a rather large supply of specimens is that of the Sphæromidæ. But the supply has not thrown much convincing illumination on the difficulties of this group, which have of late years arrested the attention of several writers. Any person of impatient temper who has ever attempted, when pressed for time, to disentangle with unskilful fingers a knotted skein of string, may understand the plight of a busy naturalist who has Sphæromidæ to classify. There is always the chance in regard to this family that, after struggling with the complexities of the situation, one may have done more harm than good, by adding to the confusion instead of lessening it. It is, indeed, a general disadvantage attending the description of a local fauna, or of a special collection, that it may involve the fragmentary treatment of problems which can only properly be solved by a monographic survey.

The tribal division of the Isopoda is here accepted from the invaluable 'Crustacea of Norway,' by Professor G. O. SARS.

DESCRIPTION OF THE SPECIES.

ISOPODA ANOMALA.

Tribe: CHELIFERA.

Family: TANAIDÆ.

Tanais, Audouin and Milne-Edwards.

1828, **Tanais**, Audouin and Milne-Edwards, 'Résumé d'Entomologie,' p. 182, pl. 29, fig. 1, and 'Précis d'Entomologie,' vol. 1, p. 46, pl. 29, fig. 1.

The genus was named *Anisocheirus* by Westwood in 1832 ('Ann. Sci. Nat.,' vol. 27), *Zeuxo* by Templeton in 1836 ('Trans. Entom. Soc.,' vol. 2, p. 201), and *Crossurus* by Rathke in 1843 ('Fauna Norwegens,' p. 35). Sars, when defining it in 1896 ('Crustacea of Norway,' vol. 2, part i., p. 11), remarked that it was well distinguished from all the other genera of the family, especially by the circumstance that the pleon was composed of only five segments and carried only three pairs of pleopods. He assigned to it only four species: *T. tomentosus*, Kröyer; *T. cavolinii*, Milne-Edwards; *T. dulongii* (Audouin); and *T. novæ-zealandiæ*, Thomson. According to Dollfus ('Bull. Soc. Zool. France,' vol. 21, p. 207, 1897) the first of them is a synonym of the second. But several other species are on record, *T. macrocheles*, Nicolet, 1849; *T. brasiliensis*, Dana, 1849; *T. loricatus*, Bate, 1864; *T. gracilis*, Heller, 1866; *T. willemoesii*, Studer, 1884; *T. hirsutus*, Beddard, 1886; and since Sars wrote, several additions have been made to the list, namely, *T. robustus*, Moore, 1894; *T. grimaldii*, Dollfus, 1897; *T. chevreuxi*, Dollfus, 1897; *T. testudinicola*, Dollfus, 1897; *T. alascensis*, H. Richardson, 1899; *T. stamfordi*, H. Richardson, 1901; *T. philetærus*, Stebbing, 1904; *T. normani*, H. Richardson, 1905. In this group it must be noticed that *brasiliensis, gracilis, willemoesii, hirsutus, robustus, testudinicola, normani*, are all excluded from the genus, not as defined by Dana, but as restricted by Sars, since they all have six segments in the pleon instead of five. It is not improbable that other more or less correlated differences will be found to exist, but the material here at disposal would not justify interference in the matter. It may, however, be observed that *T. testudinicola*, Dollfus, is evidently the same species as *T. robustus*, Moore. *T. loricatus*, Bate, described from an imperfect specimen, still awaits fuller description. *T. novæ-zealandiæ*, G. M. Thomson ('Trans. N. Zealand Institute,' vol. 13, p. 207, plate 7, fig. 3), according to the figure, has the pleon distinctly six-jointed, but no notice of this is taken in the text, which includes in the generic definition the character "pleon five-jointed."

Tanais gracilis, Heller—Plate I. (D).

1866, **Tanais gracilis**, Heller, 'Novara Exp., Zool.,' vol. 2, pt. 3 (Crustacea), p. 133, pl. 12, fig. 3.

Heller's description is as follows:—"The head very short, the roundish black eyes placed forward on the somewhat projecting lateral angles, the front bluntly triangular. The lower antennæ five-jointed, thinner than, but almost as long as, the upper, which are three-jointed. The first [coalesced] peræon segment is the largest of all, narrowed forward, the second [first free] segment the shortest, the fifth, sixth and seventh sub-equal one to the other. The pleon narrows gradually backwards. The first three pleon segments shorter than those of the peræon, but longer than the fourth and fifth pleon segment, the last (sixth) again larger and apically rounded. The uropods (Schwanzanhänge) five-jointed, their basal joint thick, triangular, the first joint of the appendage (des Anhanges) tolerably long, towards the end somewhat thickened, the four following somewhat shorter than the first, among themselves subequal, cylindrical, the last blunt-ended, all the joints beset with long setæ. The first chelipeds large and strong. The legs little setose. The colour of the body on the surface yellowish or brownish, with dark points and markings. Locality:—St. Paul." Length, 3 millims.

In Heller's account there are one or two ambiguities, for, while he speaks of and figures six segments in the pleon, he uses the expression "fourth and fifth pleon segment" as if intending to mention a composite segment, and, while he distinctly says that the uropods are five-jointed, he appears to distinguish a peduncular joint from a five-jointed ramus. His figure shows only five joints in all, as in our specimen, which was not otherwise separable from Heller's. The mouth organs agree with those in the genus *Tanais*. The upper antennæ have a fourth joint in the shape of a tubercle, representing the flagellum. The finger in the hinder group of peræopods is strongly uncinate. The pleopods are delicate in structure. Whether there were more than three pairs I did not succeed in ascertaining.

Length of specimen, 2 millims.

Locality:—Gulf of Manaar.

In *T. brasiliensis* and *T. normani* the uropods are six-jointed, in *T. willemoesii* nine-jointed, in *T. hirsutus* about twelve-jointed, in *T. robustus* four-jointed.

Heterotanais, G. O. Sars.

1880, **Heterotanais**, Sars, 'Arch. Naturv. Kristian.,' vol. 7 (1881), separat., p. 28.

1886, **Heterotanais**, Sars, 'Arch. Naturv. Kristian.,' vol. 11, p. 333.

1886, **Heterotanais**, Norman and Stebbing, 'Trans. Zool. Soc. London,' vol. 12, pt. 4, p. 108.

1896, **Heterotanais**, Sars, 'Crustacea of Norway,' vol. 2, pt. 1, p. 13.

1897, **Heterotanais**, Dollfus, 'Mém. Soc. Zool. France,' vol. 11, p. 38.

1901, **Heterotanais**, H. Richardson, 'Proc. U.S. Mus.,' vol. 23, p. 501.

The leading feature in this genus is the sexual difference in the first gnathopods, which are small and normally chelate in the female, but large and complexly

subchelate or not normally chelate in the male. It is, however, probable that up to a certain stage the males may not exhibit this distinction. The species referred to the genus by SARS are *H. örstedi* (KRÖYER), *H. limicola* (HARGER), *H. tenuis* (G. M. THOMSON), *H. anomalus*, SARS. To these DOLLFUS, in 1897, adds *H. algiricus* and *H. provincialis*, but, upon a comparison of the descriptions and figures of *H. algiricus* and *H. anomalus*, there is no character given by which they can be distinguished. H. V. HODGSON ('Nat. Hist. of the "Southern Cross,"' p. 240, 1902) remarks that but for the structure of the uropods he would have placed his own *Paratanais antarctica* and BEDDARD'S *P. dimorphus* in SARS' genus *Heterotanais.*

The species now offered as an additional member of the genus labours under the considerable disadvantage of not being represented by any adult male specimen, apart from which it is not easy to say whether junior or female specimens should be allotted to *Heterotanais* or *Leptochelia.* As will be seen by the description, if the minute character of the maxillary palp can be trusted, the species belongs to *Heterotanais.* As the first gnathopods are remarkably stout, one may be glad to rescue it from a genus like *Leptochelia* that derives its name from the slenderness of those appendages.

Heterotanais crassicornis, n. sp.—Plate I. (A).

In the cephalothorax the line of junction between the head and the first peræon segment is slightly indicated. The antepenultimate and penultimate segments of the peræon are the longest. The first five segments of the pleon are subequal, the telsonic segment not elongate.

The eyes are socketed, at apex in dorsal view apparently, but not really, acute, lenses about 12 in number.

First antennæ: first joint unusually stout, not twice as long as broad, more than twice as long as the second; third not longer than the second, very narrow, tapering, with three setæ, one of which is, perhaps, attached to a scarcely perceptible flagellar joint.

Second antennæ shorter and much narrower than the first, second joint the widest, fourth the longest, but not very long; a minute flagellar joint is tipped with a very long seta.

Mandibles nearly as figured by SARS ('Crustacea of Norway,' pl. 6) for *H. örstedi*, but on the left mandible the cutting edge and accessory plate are far less distinctly denticulate, and on the right the cutting edge shows a little tooth, the serration of the upper border being barely perceptible. There is no accessory plate on the right, and on both mandibles the molar is very prominent, as in the species described by SARS.

The first maxilla has the palp terminated by one seta, in accordance with the generic character given by SARS, whereas in the female of *Leptochelia* this organ is tipped with two setæ.

The first gnathopods are remarkably stout, the fifth joint being a little longer than broad, but almost quadrate, the sixth subequal to it in length but less broad, with the trunk a little longer than its rather broad thumb. The thumb has a slightly serrate inner margin, ends in a small tooth, and is furnished with a row of three setæ on the surface and one seta on the outer margin. The finger is more slender, with undulating inner margin.

The second gnathopods are very slender, with second joint scarcely longer than the fifth or sixth, which are subequal; the fourth joint is much shorter than these, but a little longer than the third; the slender curved finger is about as long as the sixth joint.

The peræopods are small, with the second joint decidedly longer and, especially in the last three pairs, broader than any of the other joints; the fourth and fifth joints differ little in length, each being shorter than the sixth, which is also considerably longer than the finger.

The pleopods resemble those of *Leptochelia*, having the inner margin of each oval ramus fringed with setæ, and the outer margin of the outer ramus carrying one seta placed high up.

The uropods have a six-jointed inner ramus, of which the first joint is the stoutest and the last the longest, carrying at its apex one seta as long as the ramus and one or two shorter setæ. The outer ramus, which is also tipped with a long and a short seta, is composed of two joints, the first very short, the second more than twice as long, the two together rather longer than the first joint of the inner ramus.

Length:—Of four specimens the largest measured a little over 2 millims., and the smallest a little over 1 millim. in length.

Locality:—Gulf of Manaar.

The specific name refers to the remarkable stoutness of the first antennæ, which appears to distinguish the species from any hitherto described in this genus or *Leptochelia.*

Leptochelia, DANA.

1849, **Leptochelia**, DANA, 'Amer. J. Sci.,' ser. 2, vol. 8, p. 425.
1900, **Leptochelia**, STEBBING, in WILLEY'S 'Zoological Results,' pt. 5, p. 614.
1900, **Leptochelia**, BORRADAILE, 'Proc. Zool. Soc.,' London, p. 797.
1902, **Leptochelia**, H. F. MOORE, 'Bull. U.S. Fish Comm.,' vol. 20 (for 1900), p. 165.
1902, **Leptochelia**, H. RICHARDSON, 'Trans. Connecticut Ac. Sci.,' vol. 11, p. 279.

For a fuller synonymy of this genus down to 1900, WILLEY'S 'Zoological Results' may be consulted. Mr. H. F. MOORE'S recently established Porto Rican species, *L. incerta*, is hesitatingly referred by Miss H. RICHARDSON to *L. dubia* (KRÖYER). The undesigned coincidence of dubiety and uncertainty in the specific names with the note of interrogation in the reference very appropriately marks the position of the systematist in dealing with this genus. When the generic name is justified by the presence of the extraordinarily elongated first gnathopods of the mature male, the standing ground is tolerably firm. This applies to four species, but in those leaves

the determination of female and immature specimens in obscurity. In regard to the uropods the outer branch seems to vary not only in different species but even in the same species, being sometimes two-jointed and sometimes one-jointed. The inner branch has always more than three joints.

Leptochelia mirabilis, n. sp.—Plate I. (B).

While in many of its features resembling *L. minuta*, DANA, and *L. forresti* (STEBBING), the present species is easily distinguishable from them both and from *L. rapax*, HARGER, by characters of the first and second antennæ, of the first gnathopods and the uropods, as well as by its much greater size.

The cephalothorax has the front rather broadly angled, not reaching beyond the eyes, the sides at first slightly concave, then considerably bulging. In the dorsal line the free segments of the peræon are successively longer to the antepenultimate, with a slight successive decrease in the remaining two. The first five segments of the pleon are subequally short, the telsonic segment equal to two of them combined, apically angular. The pleon at the centre is slightly wider than the peræon.

The eyes are movably socketed, dark, composed of a few large lenses.

The first antennæ are once and two-thirds as long as the body, the first joint a little swollen and bent at the base, about nine times as long as the third joint, the more slender second being about eight times the third ; the flagellum of thirteen joints, carrying sensory filaments, is between two and three times as long as the third joint.

The second antennæ are about one-fourth as long as the first, the fourth joint of the peduncle longer than the three preceding joints combined and more than twice as long as the fifth joint, which is a little shorter than the two-jointed needle-like flagellum, not including its two or three long apical setæ attached to the minute second joint.

The first gnathopods are of very surprising length, being much more than twice as long as the whole body of the animal, and while, considered in themselves, they are very slender, on the other hand, when compared with the frame that carries them, their stoutness becomes a matter for wonder. The basal joints are short, but the three terminal joints are of enormous length. The pair are not symmetrical and both members are damaged, so that exact measurements cannot be given. In the larger one the slender, apically curved, movable finger is equal in length to the first joint of the first antennæ ; it is shorter than the trunk of the hand, which widens to the hinge of the finger, and is produced to a long slender thumb or immovable finger, the apex of which is broken. The existing portion of the antepenultimate joint is longer than the trunk of the hand, and is narrower near the base than in the greater part of its length. In the shorter member the hand widens more abruptly and shows a little gap at the base of the fingers, the movable finger being sinuous, and having three little tubercles on the inner margin near the base.

Second gnathopods of quite insignificant size, agreeing in character with the first

and second peræopods, but rather longer, all the joints slender, the third very short, the sixth shorter than the second, but longer than the fourth or fifth, these being subequal, each a little longer than the very slender slightly curved finger.

The third, fourth, and fifth peræopods are shorter and stouter than the preceding pairs, with curved spines round the apex of the fifth, and small setæ round that of the sixth joint; the finger tolerably stout.

The pleopods, as in the other species and in *Heterotanais*, have the two narrowly oval subequal rami fringed on the inner margin with long plumose setæ, the outer ramus having high up on its outer margin a single adpressed seta.

The uropods have the inner ramus seven-jointed, the joints carrying numerous setæ (the apex of the seventh broken); the outer ramus has two joints, longer than the first two of the inner ramus.

Length, 6 millims. to 7 millims. For *L. minuta* and *L. forresti* the recorded length does not exceed 2·5 millims.

Locality:—Gulf of Manaar.

Leptochelia lifuensis, Stebbing—Plate I. (C).

1900, **Leptochelia lifuensis**, Stebbing, in Willey's 'Zool. Results,' pt. 5, p. 616, pl. 64c, d, pl. 65b.
1900, **Leptochelia**, sp., Borradaile, 'Proc. Zool. Soc. London,' p. 797, pl. 51, figs. 2–2c.

This species has recently been described and figured, and the illustrations here given will, I think, show that the Ceylon specimens are in substantial agreement with those from Lifu. They also show the considerable contrast between the antennæ and gnathopods of the male in this species and those in *L. mirabilis*. The question, however, remains open as to a possible dimorphism in the males, which would diminish or destroy the contrast.

Specimens in the collection from eight stations are referred to this species.

Locality, &c.:—On baskets of oysters hung to buoy at Galle: Two specimens, female; one 3·35 millims. long with seven large eggs. From pearl oysters, East Cheval Paar, Gulf of Manaar: A male, 2 millims. long; the two teeth on the thumb of the cheliped rather close together, and on one of the chelipeds not fully formed; outer ramus of uropod one-jointed, inner five-jointed. Female from same station, 2·5 millims. long and agreeing with description in Willey's 'Zoological Results.' From pearl oysters, Gulf of Manaar: Male, 2·5 millims. long; two teeth on thumb of cheliped close together; outer ramus of uropod one-jointed, very short; inner ramus imperfect. Female, 3 millims. long. Off Mutwal Island, March 19, 1902: A female, 4 millims. long; outer ramus of uropod two-jointed, inner six-jointed. Cheval Paar, Gulf of Manaar: A female, 3 millims. long; outer ramus of uropod one-jointed, inner five-jointed, the last two joints rather long; the one-jointed ramus very short. Also a female, 1·75 millims. long; outer ramus one-jointed, inner four-jointed. At each of two other points in the Gulf of Manaar a female specimen was taken. By "female" should be understood specimens without any distinctively male characters.

ISOPODA GENUINA.

Tribe: FLABELLIFERA.

Family: ANTHURIDÆ.

Calathura, Norman and Stebbing.

1886, **Calathura,** Norman and Stebbing, 'Trans. Zool. Soc.,' London, vol. 12, pt. 4, p. 122.
1897, **Calathura,** Sars, 'Crustacea of Norway,' vol. 2, p. 44.
1901, **Calathura,** Whitelegge, 'Mem. Australian Mus.,' vol. 4, pt. 2, p. 225.
1901, **Calathura,** H. Richardson, 'Proc. U.S. Mus.,' vol. 23, p. 509.

To the species *Calathura brachiata* (Stimpson) Sars has added his *C. norvegica*, Whitelegge his *C. gigas*, and Miss Richardson her *C. crenulata*. Bonnier's *C. affinis* (1896) seems rather to belong to *Paranthura*.

Calathura, sp.

Two specimens occur in the collection, one from weed-bearing oysters off south-east of Modragam Paar, the other from north end of Chilaw Paar, February 2, 1902, 9 to 11 fathoms. Both have dark eyes. The former is about 14 millims. in length, the latter about 9 millims. They may be the species which Haswell has described in 'Proc. Linn. Soc. N. S. Wales,' vol. 5, p. 478, plate 10, fig. 5, 1881, as *Paranthura* (?) *crassicornis*, sp. nov. The Australian Anthuridæ will no doubt before long be more fully described, and I have therefore left over these specimens till a more favourable opportunity offers for their specific identification.

Family: GNATHIIDÆ.

Gnathia, Leach.

1814, **Gnathia,** Leach, 'Edinb. Encycl.,' vol. 7, p. 402.
1835, **Gnathia,** Westwood, Loudon's 'Mag. Nat. Hist.,' vol. 8, p. 273.
1885, **Anceus,** Haswell, 'Proc. Linn. Soc. N. S. Wales,' vol. 9, pt. 4, p. 1005.
1887, **Anceus,** H. J. Hansen, 'Dijmphna-Togtets Krebsdyr,' p. 205.
1896, **Gnathia,** Bonnier, 'Ann. Univ. Lyon,' vol. 26, p. 571.
1900, **Gnathia,** Stebbing, in Willey's 'Zoological Results,' pt. 5, p. 625.
1901, **Gnathia,** Ohlin, 'Bihang K. Svenska Vet.-Akad. Handlingar,' vol. 26, No. 12, p. 20.
1902, **Gnathia,** Hodgson, 'Nat. Hist. of the "Southern Cross,"' p. 241.

The references here given are supplementary to the much longer list supplied in Willey's 'Zoological Results.' As the material in the present collection is limited to a single small specimen, it would not be a suitable opportunity for an extended review of the genus. Especial attention, however, should be directed to *Gnathia ferox* (Haswell), since it is evidently a near ally of the species about to be described. The details of the mandibles are similar in the two, but by the relative size and position of these features the appendages in question are strongly distinguished. The maxillipeds and first gnathopods of *G. ferox* are as yet undescribed. It is not

improbable that a separate genus will be thought desirable for these species, when they are more fully known.

Gnathia insolita, n. sp.—Plate XII. (B).

The head is very broad, markedly emarginate between the mandibles, the minute rostral point in the emargination only becoming visible after mounting, which involved some flattening of the frontal border. The telson is acutely triangular. Eyes small, dark, oval, slightly oblique in position, facets numerous.

Upper antennæ: Second joint shorter than first, first shorter than third, flagellum with very short first joint, long second, which is subequal to remaining three joints combined.

Lower antennæ: These are longer than the upper, with second joint of the four-jointed peduncle much the shortest; of the six-jointed flagellum the first joint is the longest.

The mandibles implanted wide apart are of uncommon pattern. There is no tooth on the outer margin; about midway on the inner is a quadrate process that might represent the molar; the apical part presents two strongly divergent teeth, with a small convex lamina at the bottom of the cavity between them.

The maxillipeds are of very delicate structure, except for the strong muscles in the second joint. This joint is broader than long, not showing any distinct apical lobe. In the four-jointed palp each joint is successively narrower than its predecessor. They have the outer margin fringed with setæ, 3 on the first, 5 on the second, 8 or 9 on the third, and 7 on the rounded incurved fourth joint.

The first gnathopods are very distinctive of the species, not having the ordinary tapering character, but the principal joint being as broad as it is long. Within are seen the chitinized areas, probably indicative of original joints now in coalescence. The middle area is the most extensive, the lowest has a feebly indicated companion. The upper half of the rounded margin is furnished with 21 graduated setæ. This margin is the upper and inner when these valve-like limbs are closed together, but it is not to be inferred that that is the proper description according to homology. There is a very small apical joint, with no trace of a division into two joints.

The second gnathopods are rather longer than the four pairs of peræopods, of which the second pair are slightly the shortest. In general character all five pairs of trunk-limbs agree.

The first pleopods have the rami rather longer than those of the other four pairs. All five agree with the uropods in carrying rather long setæ, which is contrary to custom in the adult male of this genus.

Length barely 2 millims., breadth a little less than half the length.

Locality:—Gulf of Manaar, off Karativo, from a sponge.

The specific name refers to the unusual characters of the mandibles and first gnathopods.

Family: EURYDICIDÆ.

(Cirolanidæ of Harger, Hansen, Bonnier, Stebbing, Norman, and others.)

Among the genera that have been assigned to this family, *Eurydice*, Leach, 1815, is beyond dispute the earliest, so that the name Cirolanidæ, notwithstanding the distinction conferred upon it as the title of Hansen's notable work in 1890, is bound to give way to Eurydicidæ. Another generic name has "page precedence" over *Cirolana*, since in 1818 Leach established *Nelocira* as his tenth genus of Cymothoadæ, and *Cirolana* as the eleventh, assigning a single species to each respectively, *Nelocira swainsoni* and *Cirolana cranchii*. These are now considered to be one and the same species. The only distinction between them which Leach supplied was that the pleon of *Nelocira* had five segments and that of *Cirolana* six. As, therefore, the generic character of *Nelocira* is erroneous, it is just that the preference should be given to the correctly described *Cirolana*, and this has been done by general consent. It is, moreover, convenient, because *Nelocira* is apt to be confused with the very similarly named but quite distinct genus which Leach at the same date called *Nerocila*.

The family at present includes seven closely connected genera, distinguished in the following synoptic table:—

1	Pleon forming only two distinct segments.	1. *Colopisthus*, H. Richardson, 1902.
	Pleon forming more than two distinct segments—2.	
2	Eyes absent; peduncle of uropods with inner apex not produced.	2. *Cirolanides*, Benedict, 1896.
	Eyes present; peduncle of uropods with inner apex produced—3.	
3	Peduncle of second antennæ four-jointed; maxillipeds without hooks on second joint.	3. *Eurydice*, Leach, 1815.
	Peduncle of second antennæ five-jointed;* maxillipeds with hooks on second joint—4.	
4	First pleopods with inner branch broad.	4. *Cirolana*, Leach, 1818.
	First pleopods with inner branch narrow—5.	
5	Head and trunk broad.	5. *Hansenolana*, Stebbing, 1900.
	Head and trunk narrow—6.	

* With regard to a sixth joint in this peduncle in *Cirolana*, *Conilera* and *Bathynomus*, see Hansen, 'Journ. Linn. Soc.,' vol. 29, p. 339.

6	First pleopods indurated; second with male appendix attached at base of inner ramus.	6. *Conilera*, LEACH, 1818.
	First pleopods not indurated; second with male appendix attached far from base of inner ramus.	7. *Conilorpheus*, n. gen., 1905.

In addition to these some authors include in this family the huge-eyed *Bathynomus*, A. MILNE-EDWARDS, 1879, which has the two abnormal characters of an accessory branch on the first antennæ and supplementary branchiæ on the pleopods, the blind *Anuropus*, BEDDARD, 1886, in which the uropods resemble the pleopods in character, and the maxillipeds have a one-jointed palp, and *Branchuropus*, H. F. MOORE, 1902, which agrees with *Anuropus* in the characters just mentioned, but differs from it by possessing eyes and in the general habit of body. I am disposed to allot *Bathynomus* to a separate family Bathynomidæ, and the other two genera to a family Anuropidæ, as already suggested for the former of them in 1893.

A. DOLLFUS ('Ann. Sci. Nat.,' Zool., Ser. 8, vol. 20, p. 271) now transfers his genus *Sphæromides*, 1898, to the family Cirolanidæ, and institutes in that family a new genus *Faucheria* for *Cæcosphæroma faucheri*, DOLLFUS and VIRÉ, 1900, to which he believes that *Spelæosphæroma julium*, FERUGLIO, 1904, is nearly allied.

Cirolana, LEACH.

1818, **Cirolana**, LEACH, 'Dict. Sci. Nat.,' vol. 12, p. 347.
1881, **Cirolana**, MIERS, 'Ann. Nat. Hist.,' ser. 5, vol. 8, p. 369.
1896, **Cirolana**, BONNIER, "Edriophthalmes du 'Caudan,'" 'Ann. Univ. Lyon,' vol. 26, p. 574.
1900, **Cirolana**, STEBBING, in WILLEY'S 'Zoological Results,' part 5, p. 629.
1902, **Cirolana**, F. MOORE, 'Bull. U.S. Fish Commission,' vol. 20 (for 1900), pt. 2, p. 166.
1902, **Cirolana**, STEBBING, 'South African Crustacea,' part 2, p. 49.
1903, **Cirolana**, DOLLFUS, 'Bull. Soc. Zool. France,' vol. 28, p. 5.
1904, **Cirolana**, STEBBING, in WILLEY'S 'Spolia Zeylanica,' vol. 2, pt. 5, p. 11.
1904, **Cirolana**, STEBBING, in GARDINER'S 'Fauna, Maldive and Laccadive Archip.,' vol. 2, pt. 3, p. 701.
1904, **Cirolana**, H. RICHARDSON, 'Proc. U.S. Mus.,' vol. 27, p. 35.
1904, **Cirolana**, NORMAN, 'Ann. Nat. Hist.,' ser. 7, vol. 14, p. 437.
1905, **Cirolana**, HANSEN, 'Journ. Linn. Soc. London,' Zool., vol. 29, p. 339.

The species assigned to this genus are now very numerous, and it must be considered a fortunate circumstance that there is no necessity for transferring them to *Nelocira*, which lapses as practically a nomen nudum. The references above given will enable the student to trace a far longer list. The blind *C. cubensis*, W. P. HAY, 1903, needs to be compared with *C. cæca*, DOLLFUS, 1903.

Cirolana sulcaticauda, STEBBING.

1900, **Cirolana sulcaticauda**, STEBBING, in GARDINER'S 'Fauna, Maldive and Laccadive Archip.,' vol. 2, pt. 3, p. 701, pl. 49B.

Of this species a specimen measuring about 6 millims. in length was taken at

Cheval Paar, and five specimens occurred in a tow-net gathering off Marichchukaddi. With the five there were four young specimens, two of which did not certainly belong to the same species. In this latter gathering there were also two specimens of a young *Idotea*.

Cirolana parva, H. J. Hansen.

1890, **Cirolana parva**, Hansen, 'Vid. Selsk. Skr.,' ser. 6, vol. 3, pp. 321, 340, pl. 2, fig. 6–6*b*; pl. 3, fig. 1–1*d*.

1901, **Cirolana parva**, H. Richardson, 'Proc. U.S. Mus.,' vol. 23, p. 514 (Localities).

1902, **Cirolana parva**, H. F. Moore, 'Bull. U.S. Fish. Com.,' vol. 20 (for 1900), pt. 2, pp. 166, 167, pl. 8, figs. 6–8.

This species is known from both the East and West Indies, and is probably to some extent variable, since Hansen and Moore agree in saying that the broad, subtriangular telsonic segment has the rounded apical margin furnished with about eight spines, while in our specimens the number appears to be uniformly six.

Moore describes the uropods as "short, reaching hardly to end of telson: rami subequal, narrow at ends, bifid, their margins furnished with spines and a few short setæ." But our specimens agree with Hansen's account, according to which the inner ramus reaches beyond the outer and is broader, and with his figure which shows it to be very much broader, so as to make the term subequal quite inapplicable.

The first antennæ have the third joint of the peduncle about as long as the composite first and second joint, the flagellum little shorter than the peduncle, nine-jointed in both adult male and female. Hansen gives it as eleven-jointed, much shorter than the peduncle, Moore as eleven- to twelve-jointed. The second antennæ have the first three joints of the peduncle very short, fourth a little shorter than the fifth, flagellum in male twenty-six-jointed, in female twenty- to twenty-two-jointed. A specimen not fully adult, having the fifth peræopods unarmed and much shorter than the fourth, had the flagellum of the first antennæ seven-jointed, that of the second fifteen-jointed.

In the maxillipeds the antepenultimate joint is furnished with only four or five setæ on the outer margin.

The first gnathopods have five blunt spines on the hind margin, the bluntness probably due to wear. At the apex of the inner margin the sixth joint in all the limbs has a rather strong spine.

The male appendix of the second pleopods is slender, the acute apex slightly incurved, reaching beyond the rami.

Length, male about 6·5 millims., breadth 2 millims.; female about the same size; specimen not adult, 3 millims. long, 1·25 millims. broad.

Localities:—Male, Chilaw Paar, Station LXIX., 8 to 11 fathoms; female with young, Muttuvaratu Paar, 10 fathoms. Specimen not adult, Talaivillu Paar.

Cirolana, sp.

The telsonic segment is smooth, triangular, with the apex almost acute, but not

quite, since a high magnification shows it narrowly truncate, carrying two spines. Each side also carries two spines just above the apex.

The eyes are rather small, lateral. The first antennæ have the third joint about as long as the composite first and second, and the flagellum of seven joints, most of which carry sensory filaments. In the second antennæ the ultimate joint of the peduncle is slightly longer than the penultimate; the flagellum is rather long, fifteen-jointed. The mouth organs are of the pattern characteristic of *Cirolana*. The limbs are rather slender, not very strongly setose or spinose, the first gnathopods being, as usual, discriminated from the succeeding legs by the position of the fifth joint. The uropods, like the telson, have a fringing of fine spines and feathered setæ; the inner apex of the peduncle is rather sharply produced about to the middle of the broad inner ramus, which narrows apically and extends beyond the telsonic segment and the narrower inner ramus. The integument is covered with scale-like markings.

The length is 5 millims., with a breadth of about 2 millims. The specimen carried several young ones, still enclosed in membranous capsules, but with the eyes already visible. I hesitate about applying a specific name, whether new or old, to this small ovigerous specimen.

Locality:—Deep water, south of Galle, depth up to 100 fathoms.

Conilorpheus, n. gen.

Only the male known. Both first and second antennæ short. First maxillæ carrying four strong plumose setæ on the inner plate. The maxillipeds having the plate of the second joint furnished with hooked spines. The male appendix of the second pleopods is attached far down on the inner ramus. The uropods have the process of the peduncle very elongate and the outer ramus much smaller than the inner.

The body is almost cylindrical, with the basal segment of the short pleon covered by the laciniated seventh segment of the peræon. In the first pleopods the peduncle is not longer than broad, and neither ramus is hard.

The generic name refers to the combination of characters, here presented, partly pointing to the genus *Conilera* and partly to the genus *Eurydice*, which takes its name from the wife of Orpheus. The first maxillæ, like those of *Bathynomus*, show an unusual feature in carrying four setæ instead of three on the inner plate, and the laciniate border of the last peræon segment is also uncommon in this family.

Conilorpheus herdmani, n. sp.—Plate II. (A).

The head is produced into a narrow distally widened process between the first antennæ; its breadth is not much greater than its length. The second and third segments of the parallel-sided peræon are the shortest; the first segment even at the forward produced sides is not longer than the seventh, of which the postero-dorsal

margin is cut into four acute lappets; between these the pleon segments, second to fifth, are partially seen. The telsonic segment narrows near the base, forming a broad oval, of which the serrate apical margin is beset with setæ and small spines.

The eyes are not large, wide apart, round.

The short stout first antennæ have the second joint of the peduncle as it were embedded in the broader first joint; the tapering flagellum is composed of seven short joints, most of them carrying sensory filaments. The second antennæ are about twice the length of the first. The third joint of the peduncle is the longest, and not much longer than broad, the fourth joint is of equal length and breadth, shorter but much broader than the fifth joint and on its obliquely truncate distal margin carrying some elongate setæ; one such seta is similarly situate on the fifth joint. The flagellum is shorter than the peduncle, nine-jointed.

The mouth-parts are as in *Cirolana*, except that the first maxillæ have four stout plumose setæ on the inner plate. The spines on the outer plate are slender. The maxillipeds are well furnished with setæ and spines, and the antepenultimate joint is large.

The first gnathopods have the second joint distally widened and the third still more so, the latter having the front apex and hind margin fringed with setæ. The fourth joint has four blunt spines on the hind margin and a long spine on the front apex; it entirely overlaps the small fifth joint which carries two blunt spines, one of them minute. The sixth joint has a stout spine between two thin ones, and some long setæ. The finger is slightly curved, nearly as long as the sixth joint, and, like the other limbs, has on the inner margin a small tooth or spine at the base of the short curved nail.

The fourth and fifth peræopods are nearly alike and about equal in length, but the second and fourth joints are longer and the fifth and sixth joints are shorter in the fifth pair than in the fourth. The side-plates are distally subquadrate in the sixth peræon segment, but are more produced and distally triangular in the seventh.

The first pleopods have the peduncle of equal length and breadth, with four delicate coupling spines. The inner ramus is rather shorter than the outer and less than half as broad. Both have the rounded distal margin fringed with plumose setæ. In the second pair the peduncle is broader than long; the inner ramus is almost as long as the outer and much more than half as broad. The male appendix is slender, apically acute, attached just above the middle of the inner margin of the inner ramus and extending considerably beyond both rami, which are armed as in the preceding pair. In all five pairs the outer ramus is broad, more or less vaulted and distally fringed with setæ. The inner ramus has some distal setæ in all but the last pair.

The uropods have the short base of the peduncle produced on the inner side into a very long process. The inner ramus is large, oval, reaching nearly to the end of the telsonic segment, and having all its free margin similarly serrate and armed with short spines and long plumose setæ. It has two or three dark markings. The outer

ramus is only half as broad and half as long as the inner, with similar armature on the distal half.

Length 6 millims., breadth 1·5 millims.

Locality:—Station V., north end of Chilaw Paar, February 2, 1902, 9 to 11 fathoms.

The specific name is chosen out of respect to the president of the Linnean Society, to whose ever watchful activity in the interests of science the collection of species here described is due.

Hansenolana, Stebbing.

1900, **Hansenolana**, Stebbing, in Willey's 'Zoological Results,' pt. 5, p. 634.

The species *H. anisopous*, for which this genus was originally established, shows, as I observed at the time, various points of resemblance to *Cirolana sphæromiformis*, Hansen. While retaining the latter in the genus *Cirolana*, Hansen himself forcibly calls attention to the singularity of its appearance. He had at command only one specimen, a female, not ovigerous, 4·25 millims. long, from St. Thomas, in the West Indies. The examination of a male specimen in Professor Herdman's collection induces me now to transfer the species to *Hansenolana*, the definition of which will in consequence require to be modified as follows:—

Head transverse, produced into a process between the two pairs of antennæ; first five segments of pleon very short. Eyes small and wide apart. Mouth organs nearly as in *Cirolana*, but on the inner plate of the first maxillæ the three setæ are spine-like and not coarsely plumose. In the second maxillæ the outer pair of plates carry very few spines. First gnathopods with the sixth joint broad. First pleopods with narrow rami. Male appendix of the second pleopods attached at some distance from the base of the ramus.

The two species which at present fall under this definition are easily distinguished:—

Apex of telsonic segment broad. 1. *H. anisopous*, Stebbing.
Apex of telsonic segment narrow. 2. *H. sphæromiformis* (Hansen).

Between these two may, perhaps, be placed *Cirolana hanseni*, Bonnier ('Ann. Univ. Lyon,' vol. 26, p. 574, 1896), originally described from an obviously juvenile specimen, and now (1905) re-described by Hansen from specimens probably still immature. In this species the telsonic segment has an apex much less broad than that of *H. anisopous*, but considerably broader than that of *H. sphæromiformis*.

Hansenolana sphæromiformis (Hansen)—Plate II. (B).

1890, **Cirolana sphæromiformis**, H. J. Hansen, 'Vid. Selsk. Skr.,' ser. 6, vol. 5, pp. 319, 351, pl. 4, fig. 3–3*g*.
1900, **Cirolana sphæromiformis**, Stebbing, in Willey's 'Zoological Results,' pt. 5, p. 634.
1901, **Cirolana sphæromiformis**, H. Richardson, 'Proc. U.S. Mus.,' vol. 23, p. 512.

Hansen's full description, together with his figures of the female, and those here

given of the male, leaves only a few points needing to be submitted or explained. The flagellum of the second antennæ has in our specimen ten joints instead of twelve. The epistome and upper lip I did not clearly make out. HANSEN does not call attention to the almost complete smoothness of the three setæ on the inner plate of the first maxillæ. The second maxillæ have three spines on the outermost plate and four on its companion. In the second pleopods the inner ramus is narrow and has the male appendix attached about one-third of its length from the base, reaching beyond both rami, and having apparently a bifid apex. The first four pairs of pleopods have setæ on both rami; the fifth pair escaped observation. In the telsonic segment, which is covered with squamose markings rather more conspicuously than the rest of the body, the three dorsal carinæ are clearly developed. But here the lateral pair appear to run without divergence and none of the three quite reach the margin of the segment, in these respects differing from the female represented by HANSEN. According to HANSEN the apex is not spinose, and he says the same of the uropods. In our specimen both the segment and its appendages carry several minute spines, which are only visible under high magnification. This is also the case in a specimen sent me from Antigua by W. R. FORREST, Esq.

In the first gnathopods the spines on the inner margin of the broad hand show a variety of minute denticulations. In this and the other limbs the point of junction between nail and finger is marked on the convex margin by a group of microscopic setules. The first gnathopods cannot claim to be subchelate, though otherwise by breadth and compactness they make some approach to the corresponding limbs in *H. anisopous*. But, whereas in that species the two following pairs are very differently and more slenderly constructed, here they show a very near agreement, in all three pairs the fifth joint underriding the sixth.

Length scarcely 3 millims., breadth 1·5 millims., the proportion being 27 : 14. HANSEN's specimen was 4·25 millims. long.

Locality :—Among compound Ascidians and with other Isopods at Reef, Galle.

The small size and deceptive appearance of this species, rather than any actual rarity or any marvel of distribution, may account for the fact that the East Indies have now revealed a solitary specimen of the male fourteen years after the West Indies had disclosed a solitary specimen of the female.

FAMILY: ARGATHONIDÆ, nov.

Mandibles, with cutting edge bidentate or simple; molar represented by a feeble blade, not serrate. First maxillæ with inner plate broadly truncate, outer strongly produced, ending in an unguis with a small curved spine at its base. Second maxillæ very short, ending in a broadly rounded single lobe. Maxillipeds six-jointed, second joint not elongate, fourth and fifth joints fused together, seventh well-developed, blunt. Male appendix of second pleopods affixed at the base of the ramus.

By the character of the mandibles this family offers a connecting link between the

Eurydicidæ and other neighbouring families, such as the Corallanidæ, but in every one of the mouth parts it presents some distinctive feature. It is at present represented only by a single specimen of a single species, so that it is not possible to say what amount of sexual dimorphism may occur.

Argathona, n. gen.

The characters of the family will at present suffice for those of the single genus. *Argathona* is a nymph or half-goddess, so recently sprung from the brain of Mr. JUSTIN HUNTLY McCARTHY, that her name is not likely to have been hitherto borrowed for scientific purposes.

Argathona normani, n. sp.—Plate III. (A).

The first peræon segment is rather the longest, and the last rather the shortest. The side-plates are diagonally furrowed, those of the second and third segments less deep than the rest, and not produced beyond their segments; the last four pairs are rhomboidal. The fourth pleon segment overlaps the fifth at the sides. The telsonic segment, with sinuous sides, becomes rather narrowly triangular as it approaches the rounded apex. The dorsal surface of the animal from one end to the other is beset with spines large or small, the only segment free from them being the first of the pleon, but also a basal area is left free where one segment slides under another, and a sinuous free area marks what is probably the boundary between the sixth pleon segment and the true telson. The sixth and seventh segments of the peræon have each six pale tubercles among the fringing spines of the hind margin; the fourth pleon segment has the same number, but less regularly spaced; the fifth has two that are submedian and much larger than those already mentioned, and the sixth segment has a pair which are quite near to the sides. The telson carries numerous spines in the serrate border besides those that belong to the dorsal cover, and is likewise fringed with long plumose setæ.

The eyes are dark, rather large, set wide apart.

The short first antennæ have the first and second joints apparently fused into one thick joint, not much longer than the following more slender joint; the flagellum, rather longer than the peduncle, is twelve-jointed.

The second antennæ have the fourth joint rather longer than the three preceding joints combined, and the fifth rather longer than the fourth; the twenty-nine-jointed flagellum is once and two-thirds the length of the peduncle.

The frontal lamina is pentagonal, not very large. The epistome forms two arms widely divergent, reaching beyond the membranaceous upper lip, in which a transverse area is perceptible of normal form, probably more highly chitinized than the remainder of the appendage.

The lower lip is longer than broad, the lobes elongate piriform, flattened on the confronting margins, the rounded apices not as usual fringed with setules, but

carrying a short tooth or spine at the inner angle, and a longer one inserted a little behind and outside the other.

The mandibles are elongate, that on the left bidentate, that on the right with the cutting edge undivided; each has a narrow, transparent, apparently very feeble blade representing the molar, but devoid of the saw-teeth which are conspicuous in *Eurydice* and *Cirolana*. The palp is implanted near the base of the trunk, its second joint much longer either than the first or falciform third.

The maxillipeds are narrow, the three terminal joints setose, none very widely expanded.

The first gnathopods are moderately robust, with four short stout spines conspicuous on the stout fourth joint; the fifth joint short, not produced along the inner side of the sixth joint, which is very slightly armed; the finger curved, simple. The second gnathopods and first peræopods agree with the preceding limb. The four following pairs have a different character, with less tendency to geniculation, except between the second and third joints. There is little difference in length between the joints from the second to the sixth, the first three of these having the expanded distal margin beset with spines of varying length, and some of the spines, especially on the hinder apex of the fifth joint, are serrate. The finger shows a little projection at the base of the nail.

The pleopods have large rami. In the second pair the male appendix, affixed close to the base of the ramus, reaches a little beyond it, and is abruptly narrowed to a short linear apex; near the base its margin is fringed with minute setules.

The uropods have the peduncle considerably produced, spinose on its outer part, but dorsally almost clear, the long process having lateral and apical armature. The rami are strongly fringed like the telson, and the broad inner ramus, which reaches a little beyond the telson, is dorsally sprinkled with short spines, but the much narrower outer ramus has much of its dorsal surface smooth, evidently to suit its habit of folding underneath its companion.

The smooth ventral surface is orange-coloured, the spiny coating of the back dark brown, the limbs quite pale.

Length of the specimen in slightly bent position, 10 millims., which is about two and a-third times the breadth. A second specimen measured 12 millims. in length by 6 millims. in breadth.

Locality:—The smaller specimen was from coral reefs, Gulf of Manaar, the larger from Station XXXIX., south of Galle, up to 30 fathoms.

The clothing of this species gives it, when under the microscope, a very striking appearance; especially its caudal fan, by the grouping and variety of the spines and the addition of the long feathered setæ in more or less symmetrical arrangement, produces a particularly agreeable effect on the eye. I have named it in honour of my friend the Rev. A. M. Norman, D.C.L., F.R.S., whose services to the zoology of invertebrates are justly celebrated.

Family: CORALLANIDÆ.

It is only necessary here to recall that the family embraces the genera *Corallana*, DANA, *Tachæa*, SCHIÖDTE and MEINERT, *Alcirona*, HANSEN, and *Lanocira*, HANSEN, with HANSEN's definition of the family Alcironidæ transferred to the modified family Corallanidæ.

Lanocira, HANSEN.

1890, **Lanocira**, HANSEN, 'Vid. Selsk. Skr.,' ser. 6, vol. 5, pt. 3, pp. 287, 313, 391, 395.
1904, **Lanocira**, STEBBING, in GARDINER'S 'Fauna, Maldive and Laccadive Archip.,' vol. 2, pt. 3, p. 706.

The species may be distinguished as follows:—

1	The hinder part of the body not setigerous.	1. *L. kröyeri*, HANSEN.
	The hinder part of the body setigerous—2.	
2	Head (of male) with frontal horn.	2. *L. gardineri*, STEBBING.
	Head without frontal horn—3.	
3	Telsonic segment with broadly rounded apex.	3. *L. rotundicauda*, STEBBING.
	Telsonic segment with narrowly rounded apex.	4. *L. zeylanica*, n. sp.

Lanocira gardineri, STEBBING.

1904, **Lanocira gardineri**, STEBBING, in GARDINER'S 'Fauna, Maldive and Laccadive Archip.,' vol. 2, pt. 3, p. 706, pl. 51 A.

For the features which may apparently be relied on for distinguishing this species from *L. zeylanica*, see the next following account of the latter form.

Locality:—One specimen of *L. gardineri* was taken at the Galle reef, with compound Ascidians and some other Isopods. A second was taken along with some small sphæromids at Cheval Paar, and a third was labelled "Gulf of Manaar."

Lanocira zeylanica, n. sp.—Plate V. (B).

The general resemblance of this species to *L. gardineri*, which I have recently described from the Maldive-Laccadive Archipelagoes, is extremely close. The distinguishing features are that the present form has the body from the fifth peræon segment to the extremity of the pleon far more strongly setigerous; that it has the front of the head with a well-marked margin and a faintly indicated longitudinal depression behind it, but no upturned frontal horn and no pair of dorsal tubercles between the eyes; that the first maxillæ are stronger; and that the fifth peræopods are armed on the third and fourth joints with far longer spines. As in the other species the second maxillæ are tipped with two setæ, but the difference in length between the two is greater here. The apical spine of the fourth joint in the first gnathopods is here stronger.

The eyes are dark. The first antennæ have a flagellum of five joints carrying sensory filaments. The mandibles with broad base and slender trunk exhibit an apical

tooth, and alongside of the plate which carries this a thin membrane, which appears to be prolonged backward into a slightly curved lingual representative of the molar, the whole apparatus being somewhat obscured by entanglement with the lower lip. The upper lip is slightly emarginate.

The curved finger of the first gnathopod shows two minute prominences on the inner margin, and one such prominence is visible on the other limbs, faintly marking the base of the nail, but the feature is not peculiar to this species. The telsonic segment has six spines at the apex.

Length 6 millims., breadth 2·75 millims.

Locality:—The dissected specimen was a male from Jokkenpiddi Paar. Two other specimens, apparently of the same species, were obtained at the south end of Cheval Paar.

FAMILY: ÆGIDÆ.

The accepted genera may be distinguished as follows:—

1	Pleon abruptly narrower than peræon.	1. *Syscenus*, HARGER, 1880.
	Pleon not abruptly narrower than peræon—2.	
2	First antennæ with flagellum of not more than six joints; maxillipeds of not more than four joints.	2. *Rocinela*, LEACH, 1818.
	First antennæ with flagellum of more than six joints; maxillipeds of not less than six joints.	3. *Æga*, LEACH, 1815.

Syscenus agrees with *Rocinela* in respect to the maxillipeds. It is now recognised that the *Rocinela lilljeborgii* described by BOVALLIUS in 1885 is identical with *Syscenus infelix*, HARGER, 1880, but it seems to have been overlooked that BOVALLIUS himself was the first to acknowledge the generic identity, and to point out the probability that *Harponyx pranizoides*, SARS, would prove to be a young *Syscenus* ('Bihang till k. Svenska Vet. Akad. Handl.,' vol. 11, No. 17, p. 17, 1887). *Ægiochus*, BOVALLIUS, is not accepted as distinct from *Æga*. *Acherusia*, LUCAS, 1849, and *Alitropus*, MILNE-EDWARDS, 1840, are regarded as synonyms of *Rocinela*; *Pterelas*, GUÉRIN, 1836, and *Ægacylla*, DANA, 1856, as synonyms of *Æga*.

Æga, LEACH.

1815, **Æga**, LEACH, 'Trans. Linn. Soc. London,' vol. 11, p. 369.
1879, **Æga**, SCHIÖDTE and MEINERT, 'Naturhist. Tidsskr.,' ser. 3, vol. 12, p. 334.
1882, **Æga**, HASWELL, 'Proc. Linn. Soc. N.S. Wales,' vol. 6, p. 11.
1890, **Æga**, H. J. HANSEN, 'Vid.-Selsk. Skr.,' ser. 6, vol. 5, p. 316.
1897, **Æga**, SARS, 'Crustacea of Norway,' vol. 2, p. 58.

In recent years species have been added to this genus by HANSEN, WHITELEGGE, H. RICHARDSON and NORMAN. Many other references to it may be traced under those given above and in company with those given below for the genus *Rocinela*.

In defining the genus LEACH laid stress on the ample development of the first two

joints of the peduncle of the first antennæ. The dilatation of these joints is used as a character also by SCHIÖDTE and MEINERT. SARS, however, employs the qualified statement, "the first two peduncular joints more or less expanded," and, in fact, describes the antennæ as very slender both in *Æga arctica*, LÜTKEN, and *Æga ventrosa*, M. SARS. The absence of any expansion from the two peduncular joints in question is conspicuous in the figures given by SCHIÖDTE and MEINERT of their species *Æga nodosa*. They further speak of the frontal lamina, that is, the plate above the upper lip between the bases of the second antennæ, as large or very large in *Æga*, but minute or evanescent in *Rocinela*. But, taking all the species of the two genera together, this distinction does not seem to be stable.

In the species about to be described the peduncular joints of the first antennæ are not specially dilated and the frontal lamina is not very large. But while in these respects it makes an approach to *Rocinela*, it is clearly separated from that genus by the flagellum of the first antennæ and by the maxillipeds. Its peculiarities tempted me to make it the type of a new genus, but I am content to leave it for the present as a very distinct unit among the many species of the genus *Æga*.

Æga ommatophylax, n. sp.—Plates IV., V. (A).

The very marked and at present seemingly unique feature of this species pertains to the first peræon segment of the male. The anterior border of this segment projects a sub-median pair of cylindrical processes over the large contiguous eyes. The specific name has been chosen to suggest that their function is protective to the organs of vision. In *Rocinela cornuta*, RICHARDSON, the antero-lateral angles of the first peræon segment are extended straight forwards, probably with the same object. The defence obtained is presumably worth the interference with sight that must result from it.

Male. The head projects a distally widened round-ended frontal process slightly upturned, with the exception of this process having its dorsal surface almost completely and its ventral surface partially covered by the dark eyes. The first peræon segment, without including its slightly convergent antero-dorsal processes, is longer than any of the other segments, these varying little among themselves in length or breadth. The first five segments of the pleon are but little narrower than the peræon and are subequal one to the other, somewhat wider than the telsonic segment, which is broader than long, with its broadly rounded apical margin serrate, carrying spines and setæ and having the central point a little produced.

The eyes meet in the middle line of the head, leaving a little triangular interval above, but occupying all the hind margin.

The frontal lamina is not large. The bases of the first antennæ are concealed from above by the front of the head, and have a slender peduncle with flagellum thirteen- to fourteen-jointed. In the second pair the joints of the slender peduncle increase in length from the second to the fifth, and the flagellum is thirty-two-jointed.

The upper lip appears to be rounded, membranaceous. The mandibles have the palp planted near the base of the trunk, with the first joint nearly as long as the second, the third not very short. The first maxillæ are long and slender, the small apex carrying three hooked spines and four spinules. The second maxillæ are much broader than the first, having the inner margin of the apex armed with three little hooks, in addition to which a small, narrowly oval, movable inner plate is tipped with two hooks. The maxillipeds have an irregularly rounded epipod, as wide as the second joint, which is itself wide, elongate, and produced into a narrowly tapering process tipped with two setules. The third joint is short, distinct, the fourth and fifth have distinct outlines, but are, perhaps, only apically separate, the fifth carrying outward curved spines at its apex, its outer margin forming a continuous curve with the faintly separable sixth and seventh joints, which together have a free inner margin tipped with two outward curving spines. As will be seen from the figures, this account of the mouth organs in the male has been a little supplemented from the mouth organs of another specimen possibly of a different sex.

The first gnathopods have a few short finely plumose setæ along the front margin of the rather narrow second joint, and the same garniture seems to occur on the corresponding margin in the other limbs. The third joint is rather longer than the fourth and carries a single spine at its front apex. The fourth joint has two stout spines on the hind margin, the fifth is small, underriding the sixth, but not overlapped in front by the fourth; its spines like those of the hand are slight. The finger is nearly as long as the hand, with setules marking the base of the nail.

The second gnathopods are very similar to the first, but stronger and more spinose. The third joint has a stout spine on the hind margin, and the fourth has four or five such spines; the fifth joint does not underride the sixth. The first peræopod is of nearly the same appearance. On the left side of the specimen each of these limbs has, on the inner apex of the short fifth joint, an articulated obtuse process about twice as long as it is broad, giving the limb a subchelate character. On the right side of the specimen these processes are not present. Whether they are abnormal growths on the left side or are accidentally missing from the right I cannot determine.* The side-plates of the second gnathopods are round-ended. In the following limbs they tend to become less and less obtuse and those of the fifth peræopods are subacute, produced over the first segment of the pleon, of which, however, the angles are free.

In the last four pairs of peræopods the third joint attains a considerable length, this and the three following joints being armed with numerous well developed spines, of which a group on the hind apex of the fifth joint, though not very long, are

* It is worth noting for comparison that SARS ('Crustacea of Norway,' vol. 2, p. 61) describes the three anterior pairs of legs in *Æga crenulata*, LÜTKEN, as "distinguished by a very conspicuous cultriform spine, issuing from the end of the propodos, inside the base of the dactylus," and WHITELEGGE ('Mem. Australian Museum,' iv., pt. 2, p. 233) describes a similar process on first peræopods of his *Æga angustata*.

distinguished by their pectinate character. The genital papillæ on the ventral side of the last peræon segment are short and broad.

In the first pleopods the sinuous inner margin of the peduncle carries seven coupling spines and as many plumose setæ. The outer branch, as in the following pairs, is fringed round most of its margin with plumose setæ. The inner branch in this and the next pair has a fringe of setæ on the lower half of the inner margin and on the apical border. The second pair are distinguished by the extraordinary length of the slender male appendix, which is twice as long as the trunk of the supporting branch.

The uropods have the inner apex of the peduncle greatly produced into an acute process, of which the inner margin is setose. The broad inner ramus is mostly fringed with plumose setæ and carries eleven spines in the serrate part of its margin. The shorter and much narrower outer ramus is fringed also with plumose setæ and carries nine spines.

Length 14 millims., breadth about 6 millims.

Locality:—The single specimen, a male, was taken in "deep water off Galle."

A specimen which I deem to be the female or a younger form of the foregoing was "dredged off Mutwal Island," and measured 12 millims. in length, with a width of about 4·5 millims. It is devoid of the frontal process of the head, and the first peræon segment is without the two submedian dorsal processes. The last three segments of the peræon more decidedly surpass in length the preceding three segments than in the form already described; the first antennæ have twelve and the second antennæ have twenty-six joints to the flagellum. The peculiar process of the wrist in the second gnathopod and first peræopod is wanting. No male appendix could be discerned in the (undissected) pleon. Otherwise the agreement of the two specimens is extremely close. The remarkable eyes are alike in both, and though they agree with those of *Rocinela vigilans*, Haswell, that much larger species, if the figure of the maxillipeds can be trusted, must be generically distinct. The tenacity with which some of the mouth parts in this and kindred species cling together makes satisfactory dissection difficult. But there is little reason to doubt that the frontal lamina, epistome, and rounded membranaceous upper lip figured from the second specimen would equally well represent those parts in the first, had they there been in a condition for figuring. *Æga cyclops*, Haswell, is described as having the eyes confluent, the telsonic segment sub-triangular.

Rocinela, Leach.

1818, **Rocinela**, Leach, 'Dict. Sci. Nat.,' vol. 12, p. 349 ("*Rocinèle*," p. 348).
1825, **Rocinela**, Desmarest, 'Consid. gén. Crust.,' p. 304.
1849, **Acherusia**, Lucas, 'Explor. Algérie, Crust.,' p. 78.
1867, **Rocinela**, Bate and Westwood, 'Brit. Sessile-eyed Crust.,' part 18, vol. 2, p. 289.
1879, **Rocinela**, Schiödte and Meinert, 'Naturhist. Tidsskr.,' ser. 3, vol. 12, p. 380.
1880, **Rocinela**, Haswell, 'Proc. Linn. Soc. N. S. Wales,' vol. 5, p. 472.
1883, **Rocinela**, Harger, 'Bull. Mus. Comp. Zoöl.,' vol. 9, art. 23, p. 97.

1890, **Rocinela**, H. J. Hansen, 'Vid. Selsk. Skr.,' ser. 6, vol. 5, pp. 298, 316, 406.
1893, **Rocinela**, Stebbing, 'History of Crustacea,' p. 348.
1896, **Rocinela**, Bonnier, "Édriophthalmes du 'Caudan,'" 'Ann. Univ. Lyon,' vol. 26, p. 578.
1897, **Rocinela**, H. J. Hansen, 'Bull. Mus. Comp. Zoöl.,' vol. 31, p. 108.
1898, **Rocinela**, H. Richardson, 'Proc. Amer. Philos. Soc.,' vol. 37, No. 157, p. 8.
1899, **Rocinela**, Sars, 'Crustacea of Norway,' vol. 2, p. 65.
1899, **Rocinela**, H. Richardson, 'Proc. U.S. Mus.,' vol. 21, p. 827.
1900, **Rocinela**, H. Richardson, 'American Naturalist,' vol. 34, No. 399, p. 218.
1901, **Rocinela**, H. Richardson, 'Proc. U.S. Mus.,' vol. 23, pp. 520, 523.
1902, **Rocinela**, H. F. Moore, 'Bull. U.S. Fish Commission,' vol. 20 (for 1900), pt. 2, p. 171.
1903, **Rocinela**, H. Richardson, 'Bull. U.S. Fish Comm. for 1903,' p. 49.
1904, **Rocinela**, H. Richardson, 'Proc. U.S. Mus.,' vol. 27, p. 33.

In 1898 Miss Harriet Richardson reckoned the then known species of this genus at nineteen, of which she provided a useful analytic key. Bonnier's blind species, *R. typhlops*, 1896, had probably at that time not come under her notice, as it is not included in the list. On the other hand, one of the accepted nineteen is the Tasmanian species which G. M. Thomson named *R. spongicola* in 1892 (1893). Since this has about fourteen joints to the flagellum of the first antennæ and a distinct third joint to the maxillipeds, it should be transferred to the genus *Æga*. In 1899 Miss Richardson made *R. alaskensis* (Lockington) a synonym of *R. belliceps*, which Stimpson had assigned to the genus *Æga*. In 1903 she described *R. hawaiiensis* as a new species, near to *R. orientalis*, and in 1904 established a new species, *R. affinis*, near to Harger's *R. oculata*, and gave the name *R. angustata* to a form which she had previously supposed identical with Hansen's *R. laticauda*. In 1902 Lanchester instituted *R. mundana* ('Proc. Zool. Soc. London,' p. 378, pl. 35, figs. 9–9*a*).

Rocinela orientalis, Schiödte and Meinert.—Plate VI. (C).

1879, **Rocinela orientalis**, Schiödte and Meinert, 'Naturhist. Tidsskr.,' ser. 3, vol. 12, pp. 383, 395, pl. 13, figs. 1, 2.
1898, **Rocinela orientalis**, H. Richardson, 'Proc. Amer. Philos. Soc.,' vol. 37, No. 157, pp. 9, 11.

This species belongs to a group distinguished by the Danish authors as having the eyes clearly separated, the flagellum of the second antennæ composed of fourteen to sixteen joints, and the sixth joint in the first three pairs of trunk-limbs armed with three or four spines. To distinguish it from its neighbours in this group, Miss Richardson notes that the frontal margin is not produced as it is in *R. dumerilii* (Lucas), and that, whereas Schiödte and Meinert's *R. maculata* and *R. americana* have the telsonic segment "linguate," and both branches of the uropods crenulate on their exterior margins, in the present species the telsonic segment is subtriangular and the branches of the uropods are not crenulate on their exterior margins. The Danish authors mention the crenulation in the two former species, but neither deny nor affirm it in regard to *R. orientalis*, the telsonic segment of which they describe as subtriangular, with rounded sides, a phraseology quite as applicable to their figures of

that segment in *R. americana* and *R. maculata*. A more tangible distinction appears to lie in the proportions of the uropods, which in both the species last mentioned are said to have the inner branch a little longer and broader than the outer, while in the present species it is described as much longer and a little broader. Probably it was not the absolute length of each branch that was taken into comparison, but the inner branch was reckoned the longer by all that part of it which extended beyond the outer branch. It will be seen by the figures here given, that, if the specific determination is correct, the telsonic segment is subject to some variation, the apical margin passing from the subtriangular to a rather broadly rounded contour. In either case the margin is minutely serrate and fringed with minute spines and short plumose setæ. The uropods have the margins a little more strongly serrate and the armature rather stronger. Their peduncle is greatly produced at the inner apex, and the long process is rather strongly fringed with setæ.

In the first antennæ the flagellum is six-jointed, but in the smaller and perhaps not fully adult specimen five-jointed. The second antennæ have a long spine on the apex of the fourth joint of the peduncle, the flagellum in the male specimen with fourteen joints on one antenna and fifteen on the other, many of the joints fringed with setules. In the smaller specimen the flagella were twelve- and thirteen-jointed.

In the mandibles the first joint of the palp is the longest. The terminal joint of the maxillipeds has two outward curving apical spines, and a similar spine below the apex (this, however, not being clearly discerned in the male specimen).

The fingers of the prehensile legs are strongly hooked. The ambulatory legs have the third joint very elongate, especially in the last pair.

The first pleopods have both branches narrow, fringed with setæ, except on much of the outer border of the inner branch. The second pleopods have the outer branch longer and much broader than the inner. In both the margin is somewhat irregular and much of it fringed. The male appendix does not reach the end of the inner branch.

Length of largest specimen, male, 13 millims., with a breadth of 7 millims. The smaller specimen figured was 11·3 millims. long by 5 millims. broad. A specimen laden with eggs was 12 millims. long, 5·75 millims. broad.

Localities:—Station I., off Negombo, 20 fathoms; Station II., off Uluwitti, 8 fathoms; Station V., Chilaw Paar, 10 fathoms; on weed bearing oyster spat, S.E. of Modragam Paar.

Family: CYMOTHOIDÆ.

Anilocra, Leach.

1818, **Anilocra**, Leach, 'Dict. Sci. Nat.,' vol. 12, pp. 348, 350.
1900, **Anilocra**, Stebbing, in Willey's 'Zoological Results,' pt. 5, p. 639.
1901, **Anilocra**, H. Richardson, 'Proc. U.S. Mus.,' vol. 23, p. 528.
1902, **Anilocra**, H. F. Moore, 'Bull. U.S. Fish Comm.,' vol. 20 (for 1900), pt. 2, p. 172.

Anilocra dimidiata, Bleeker.

1857, **Anilocra dimidiata**, Bleeker, 'Acta Soc. Sci. Indo-Neerl.,' vol. 2, art. 5, pp. 30, 31.
1881, **Anilocra dimidiata**, Schiödte and Meinert, 'Nat. Tidsskr.,' ser. 3, vol. 13, p. 103, 111, pl. 8 (15), figs. 5, 6.
1900, **Anilocra dimidiata**, Stebbing, in Willey's 'Zoological Results,' pt. 5, p. 639.

The two specimens obtained agree closely with the description given by Schiödte and Meinert, having, in accordance with their conspectus of the species in this genus, the first antennæ geniculate, the coxæ not carinate but simple, and the fingers in the first four pairs of trunk-legs inflated in the middle, the inflation here forming a single nodule, not two or three nodules as in *A. leptosoma*, Bleeker. The colouring also agrees, not merely in being yellow, bespattered with minute dark specks, which is common to so many preserved species, but in the much more peculiar character of being very much darker on the right side of the animal than on the other, in accordance with Bleeker's description. Schiödte and Meinert write as though either side might be the darker.

The Danish authors speak of their specimens being more or less twisted to the right, whereas ours are quite straight as in Bleeker's figure. They attribute only nine joints to the second antennæ, while ours have these appendages ten-jointed. Both first and second antennæ, and the latter especially, are much compressed. In one specimen both members of the second pair, and in the other one member, have the antepenultimate joint shorter than either of its neighbours.

The fifth pleon segment has the postero-lateral angle produced a little over the telsonic segment, which is broader than represented by Schiödte and Meinert, but is, as they describe, obscurely carinate, with raised lateral margins. The peduncle of the uropods is only shortly produced on the inner apex; the long narrow rami are perfectly smooth, approximately equal in length, the outer a little the narrower.

One specimen, carrying elongate eggs, measured 24 millims. in length, the other being 22 millims. long. In each case the greatest breadth was 8 millims.

Locality :—Palk Bay, 6 fathoms.

Rhiothra, Schiödte and Meinert.

1884, **Rhiothra**, Schiödte and Meinert, 'Nat. Tidsskr.,' ser. 3, vol. 14, p. 223, 318.

This genus is placed by the Danish authors in the Cymothoinæ, the second tribe of their family Cymothoidæ. In the somewhat conjectural reference to it of a single specimen, a male not fully grown, it would be out of place to indulge in any long discussion of the characters, for which the original work should be consulted. It may be remarked that the generic definition refers to the female, not to the adolescent male, in which the second antennæ have a larger number of joints.

Rhiothra callipia, Schiödte and Meinert.—Plate VI. (A).

1884, **Rhiothra callipia**, Schiödte and Meinert, 'Nat. Tidsskr.,' ser. 3, vol. 14, p. 319, pl. 12, figs. 8–13.

The single specimen here available agrees with the account of the "mas adolescens"

given by the Danish authors as well as could be expected considering its smaller size. The slender second antennæ, however, consist of thirteen joints instead of twelve. The eight-jointed first antennæ have the five joints of the flagellum each apically furnished with a spray of sensory filaments. The male appendix of the second pleopods, which the above-named authorities describe as very thin, hooked, scarcely reaching the end of the rami, is, in our example, only a third as long as the rami, not especially thin, and not showing any perceptible hook. The coupling spines of the peduncle are numerous. The delicately laminar rami of the uropods have fringes of finely plumose setæ and are scarcely, or not at all, shorter than the telsonic segment, the broadly rounded hind margin of which is fringed with very short but finely plumose setæ. Its base carries dorsally numerous setules, of which there are a few on the preceding segments. The pleopods are without setæ, according to the custom of the family Cymothoidæ.

A feature of our specimen, to which SCHIÖDTE and MEINERT make no allusion, is, that in all the limbs the fifth joint has the inner apex protruding, acutely in the first gnathopod, broadly in the fifth peræopod, where it is armed with three spines. The third joint is remarkably short in the former, but tolerably long in the latter pair of limbs. In all the limbs the finger is strongly uncinate.

Colour orange yellow, lightly sprinkled with small dark flecks, especially on the sides, the limbs pale.

Length about 6·75 millims., breadth about 2·75 millims.

Locality :—Station LVIII., off Karativo Paar, 9 to 26 fathoms.

Irona, SCHIÖDTE and MEINERT.

1884, **Irona**, SCHIÖDTE and MEINERT, 'Nat. Tidsskr.,' ser. 3, vol. 14, pp. 327, 381.
1897, **Irona**, H. J. HANSEN, 'Bull. Mus Comp. Zoöl. Harvard,' vol. 31, p. 110.
1901, **Irona**, H. RICHARDSON, 'Proc. U.S. Mus.,' vol. 23, pp. 525, 531.

This genus was placed by its authors in the Livonecinæ, the third tribe of their family Cymothoidæ. From the seven other genera which they assign to the same tribe it is distinguished by one or more of the following characters :—Segments of the pleon clearly separate, fifth peræopods subequal in length to the preceding legs, or a little longer, with uncinate fingers, the body all moderately convex, the front broadly or shortly rounded, the pleon deeply immersed in the peræon.

In the definition of the genus nothing is said as to the mouth organs or the character of the pleopods. Four species were placed in the genus, to which HANSEN has since added a fifth, *I. foveolata*. This last agrees with the species about to be described in a rather striking feature, of which HANSEN gives the following account :— The side-plates of the sixth, and especially of the seventh, segment are much broader and posteriorly much more produced than the others, besides on each side rising considerably above the more lateral part of the dorsal surface of the thorax [peræon], which is brought about by the curious fact that these epimera are turned outwards

and somewhat upwards." In *Cterissa pterygota* (KOELBEL) there is a similar expansion of the side plates, but it applies to all six of them on one side of the animal and to none on the other side.

Irona nanoides, n. sp.—Plate VI. (B).

The specimen, a female, having its pouch enormously distended with young ones, was slightly distorted so as to make the outline of the left side very convex. The middle of the back is raised considerably above the lateral parts of the segments. The head has a short, very broad front. The peræon is very broad, the side-plates of the fifth segment approaching the character of the two following pairs. The first two segments of the pleon are overlapped by the last segment of the peræon, the next three are very short but wider than the almost semicircular telsonic segment.

The eyes are wide apart, not very large, black. The first antennæ are rather stout, especially as to the first three of the eight joints. The ten-jointed second pair are slighter, subequal in length. The upper lip has a four-lobed margin as in *Anilocra curieri*, LEACH, and in *Renocila periophthalmi*, STEBBING. The mandibles have a stout first joint to the palp, the second much thinner and a little shorter, the third shorter and thinner than the second, and armed with a few spines. The trunk thins out in advance of the palp, apparently carrying a quasi-molar not very remote from the pointed cutting-plate. The slender first maxilla is tipped with five spinules. The second maxilla appears to have a membranous apical margin accompanied by a process carrying small hooked spines. The maxillipeds have the composite second and third joints long and broad, followed by a joint which is about equal in length and breadth, narrowed at the rounded apex, to which is attached the narrow terminal bearing two outward bent hooks at its summit and one such hook on its side.

The gnathopods and peræopods are all very similar in appearance and structure, the hinder pairs having some superiority of size. The second joint is substantial, but not conspicuously expanded; the third in the gnathopods is as long as the hand, but in the hinder peræopod is longer than any one of the joints that follow it; the fourth joint is short but wide, being especially bulging in the fifth peræopod; the fifth joint is of insignificant size, tending slightly to underride the short curved hand, which does not exceed in length the simple but strongly hooked finger.

The pleopods are all of remarkable breadth, both branches similar in structure and devoid of setæ. The coupling spines of the short peduncles are small. The uropods are short, with two subequal oval branches, little longer than the stout peduncle, of which the inner apex is not produced. There are some tiny spinules on the branches, of which the inner is decidedly not longer than the outer. Colour in spirit yellow, with the upturned side-plates whitish.

Length 10 millims., greatest breadth 5·5 millims.

Locality :—Station XXXIX., Gallehogalle Bank, 16 to 20 fathoms.

The young ones taken from the mother's pouch have the broad front to the head as

in the adults and the eight-jointed first antennæ. In the limbs the nail is rather more distinct from the trunk of the finger than it is in the full-grown animal. The seventh segment of the peræon is, as usual, without limbs, and resembling the segments of the pleon which at this stage are much narrower than the peræon. The telsonic segment shows a broadly rounded or very obtusely-angled apical margin, which like those of the uropods, and possibly also those of the pleopods, is feebly and microscopically fringed with setules. There is no subapical constriction of the telsonic segment as in the "pullus stadii primi" of *Irona foveolata*, and the inner branch of the uropod is broader than in the young of that species.

In *Irona nana*, Schiödte and Meinert, the adult female has the outer branch of the uropod much longer than the inner; in Hansen's species the inner is considerably longer than the outer, so that both species may be easily distinguished from the one here described.

Family: SPHÆROMIDÆ.

The genera that with more or less acceptance have maintained places in this family are *Sphæroma*, Bosc, 1802; *Campecopea*, Leach, 1813; *Cymodoce*, Leach, 1814; *Dynamene*, Leach, 1814; *Næsa*, Leach, 1815 (for *Nesæa*, Leach, 1813, preoccupied); *Cilicæa*, Leach, 1818; *Zuzara*, Leach, 1818; *Cerceis*, *Amphoroidea*, *Cassidina*, *Ancinus*, all four instituted by Milne-Edwards in 1840; *Monolistra*, Gerstaecker, 1856; *Isocladus*, Miers, 1876; *Ceratocephalus*, Woodward, 1877 (not preoccupied by *Ceratocephala*, Warder, 1838, and therefore taking precedence of *Bregmocerella*, Haswell, 1885); *Cycloidura*, Stebbing, 1878 (for *Cyclura*, Stebbing, 1874, preoccupied); *Scutuloidea*, Chilton, 1882; *Plakarthrium*, Chilton, 1883 (of which *Chelonidium*, Pfeffer, 1887, is a synonym, so that the family Chelonidiidæ if maintained must be named Plakarthriidæ); *Haswellia*, Miers, 1884 (for *Calyptura*, Haswell, 1881, preoccupied); *Cymodocella*, Pfeffer, 1887; *Næsicopea*, Stebbing, 1893; *Cæcosphæroma*, Dollfus, 1896 (part); *Tecticeps*, H. Richardson, 1897; *Exosphæroma*, Stebbing, 1900; *Cassidinella*, Whitelegge, 1901; *Chitonopsis*, Whitelegge, 1902; *Parasphæroma*, Stebbing, 1902; *Vireia*, Dollfus, 1905.

This rather unwieldy group suffers at present under various difficulties, towards the solution of which only a few suggestions can here be volunteered. Eugène Hesse in 1872 undertook to prove, with a reserve which he evidently scarcely entertained, that *Sphæroma* represented the female of *Cymodoce* and *Dynamene* the female of *Næsa*. The discovery of undoubted males in several species of *Sphæroma* has shown that the first part of his hypothesis is untenable, but for the second part there is much to be said. It is exceedingly probable that *Dynamene montagui*, Leach, is the young male, and that *Dynamene rubra* and *viridis*, Leach, are young forms, female or male, of *Næsa bidentata* (Adams), which is the adult male. The colouring, the general structure, and very frequent occurrence under similar conditions of these four forms give warrant to this belief (see 'Journ. Linn. Soc.,' London, vol. 12, p. 148, 1874). From acceptance of this view will follow the necessity of cancelling one of the generic

names. *Nesæa*, Leach, has priority, but is preoccupied. *Næsa* was substituted for it. But *Dynamene* has priority over *Næsa*, although its title is a little peculiar. It was indeed defined in advance of the substituted naming of *Næsa*, but the species for which it was defined were not specified by name until 1818. The simplest issue out of the complication seems to be by reducing the two genera and their four representative species to a single genus and species under the name *Dynamene bidentata* (Adams). Thus *Næsa* disappears, and *Dynamene* in its place acquires an intelligible status.

The relief, however, is not very great, because there are several other species that have been assigned to this dimorphic genus before its dimorphism was understood, and of these the true generic position remains uncertain.

Although sexual dimorphism is not conspicuous in *Sphæroma*, *Exosphæroma*, or *Parasphæroma*, in many other genera of the family it has been more or less clearly established, and there exists at least a possibility that the females of different genera may be much less divergent in appearance than the males. The latter sex is distinguished in *Dynamene* and *Campecopea* by having the sixth segment of the peræon dorsally produced, in *Zuzara*, *Cycloidura*, *Isocladus*, and *Haswellia* by having the peræon's seventh segment so produced. In *Dynamene*, *Campecopea*, *Cilicæa*, and *Næsicopea* the males have the inner ramus of the uropods degraded (with an exception subsequently mentioned). In *Ancinus* that ramus is wanting, but the sexes have not as yet been discriminated either in that genus or in *Tecticeps*, which shows a near relationship to it. The uropods in *Tecticeps* are biramose, with the inner branch much the shorter.

In regard to some isolated members of the family, it may be suggested that *Sphæroma algoense*, Stebbing, 1875, *Cymodocella tubicauda*, Pfeffer, 1887, and *Sphæroma* (?) *egregia*, Chilton, 1891, must all belong to the same genus, and may possibly deserve to be united under the name *Cymodocella algoensis*. *Cymodocea antarctica*, Hodgson, 1902, also appears to approach *Cymodocella* more nearly than *Cymodoce*. *Exosphæroma amplifrons*, Stebbing, would, according to my present view, stand better in the genus *Cymodoce*, and, in any case, I agree with my friend Dr. H. J. Hansen that it cannot properly be retained under *Exosphæroma*.

Since the above was written, Mr. Holmes has kindly sent me his interesting essay on the sexes of Sphæromids ('Proc. California Ac. Sci.,' ser. 3, Zool., vol. 3, p. 295). He takes the view that the name *Dynamene* should be accepted in place of *Næsa*, but further extends it to supersede *Cilicæa*, a procedure which can scarcely be accepted without more consideration and argument. As regards the male sex, *Cymodoce* seems fairly distinguishable by superficial characters from *Dynamene* and both sections of *Cilicæa*, but whether there are stable and sufficient marks for separating either the female or the juvenile forms of *Cymodoce* and *Cilicæa* in all cases is less clear. The addition of new species without tolerably full description and figures is rather to be deprecated than welcomed.

Sphæroma, Bosc.

1802, **Sphæroma**, Bosc, 'Hist. Nat. des Crustacés,' vol. 2, p. 182.
1873, **Sphæroma**, Harger, 'Amer. Journ. Sci.,' ser. 3, vol. 5, p. 314.
1880, **Sphæroma**, Harger, 'Rep. U.S. Fish. Comm. for 1878,' p. 368.
1900, **Sphæroma** (*sensu restricto*), Stebbing, 'Proc. Zool. Soc. London,' p. 552.
1904, **Sphæroma**, Stebbing, in 'Spolia Zeylanica,' vol. 2, pt. 5, p. 15.
1904, **Sphæroma**, Stebbing, in Gardiner's 'Fauna, Maldive and Laccadive Archip.,' vol. 2, pt. 3, p. 710.

The definition of the restricted genus may be formulated as follows:—Sexual dimorphism not conspicuous. Telsonic segment without apical sinus. Maxillipeds having the fourth and fifth joints fringed on the inner margin with long setæ, but neither these two joints nor the sixth produced into lobes. First and second gnathopods having the third and fourth joints fringed on the front margin with long setæ. Uropods with subequal rami.

Conforming to these characters are the type species, *S. serratum* (Fabricius), *S. terebrans*, Bate, *S. quadridentatum*, Say, and *S. walkeri*, n. sp. In the multitude of species which from early dates down to the last two or three years have been assigned to *Sphæroma*, there are many which are obviously excluded from that genus as above defined. But there are several of which not enough is known to enable us to say whether they belong to it or not. There is a presumption in favour of *S. quoianum*, Milne-Edwards, since Heller in re-describing that species says that the first three pairs of feet have the middle joints fringed on the outer side with long hairs, and there is a similar presumption in regard to *S. sieboldii*, Dollfus, 1889, and *S. pentodon*, H. Richardson, 1904. On the other hand, Whitelegge, describing *S. australe*, *S. latifrons*, and *S. plumosum* in 1902, speaks of the lobes in the palp of the maxillipeds as well developed. At least the first of these three may be referred with some certainty to *Exosphæroma*.

Sphæroma walkeri, n. sp.—Plate VII.

Head not very broad or long. Peræon convex, its segments not greatly differing in length, although a contrary impression may be produced by the telescoping or extension of a particular segment. The unsutured side-plates of the first segment are as usual much the longest, being subacutely outdrawn backwards and forwards. The next two pairs are apically narrowed, the following three somewhat squared, and the seventh pair with a rather deep trituberculate hind margin. The transverse tuberculation of the segments, which is scarcely perceptible on the first segment, gradually increases in prominence, and fringes the seventh segment in a very pronounced manner. In the front division of the pleon, representing five faintly distinguishable segments consolidated into one, there is a curved transverse row of tubercles, belonging chiefly to the fourth segment. The telsonic segment is only moderately convex, and becomes slightly concave near the broadly rounded, slightly

crenulate apical margin. This shield is ornamented by four longitudinal rows of tubercles, two submedian, of about eight tubercles apiece, and two sublateral of four, which lead to an encircling apical ridge, the sloping sides of the shield carrying at the upper part short divergent lines of tubercles, and usually a little tubercle outside each sublateral line.

The eyes are dark, deeply inserted in the front margin of the peræon.

The first antennæ have a broad basal joint, probably representing two joints consolidated. The following joint is small, scarcely as long as broad. The flagellum in the specimen examined consisted of fourteen joints, the first much the longest, as long as the basal and twice as long as the terminal joint of the peduncle.

The slender second antennæ are rather longer than the first; the fourth and fifth joints of the peduncle are equal in length; the flagellum is fourteen-jointed, rather longer than the peduncle.

The epistome is somewhat longer than broad; the upper lip has a feebly trilobed margin.

The gastric spines on the folds of the stomach at its entrance display a variety of shapes, which, however, may be customary.

The mandibles have the molar strong and prominent, the palp less slight than usual. In both pairs of maxillæ the plates appear to be somewhat broader than is usually the case.

The maxillipeds have the plate of the second joint broad, strongly setose round the convex distal margin and down the surface at some distance from the inner margin. The latter is armed with an exceptionally long and slender upward-bent coupling spine. The third joint is exceedingly small, the fourth as broad as long, with inner margin narrower than the outer, the fifth about square, like the preceding joint having its inner margin densely fringed with long setæ; the sixth and seventh joints are subequal, apically setose, considerably longer and narrower than the fifth joint.

The first gnathopods have the hind margin of the second joint setose in its upper part, the third joint nearly as long, with the plumose setæ of the front margin very long; the much shorter fourth joint has long plumose setæ on the convex front margin; the triangular fifth joint is quite small; the sixth joint is about as long as the fourth, with short plumose setæ distally on the front margin and a serrate spine at apex of hind margin; the finger has minute setules along the concave hind margin.

The second gnathopod differs from the first chiefly by the cylindrical fifth joint, which is nearly as long as the sixth, the former carrying plumose setæ at its front apex, and both being setose along the hind margin.

The peræopods are fringed with setæ on the front margin of the second, third, and fourth joints, and on the hind margin of all joints from the second or third to the sixth in the first two pairs, and on the corresponding but inverted margins of the other three pairs. The second and third joints are more robust than in the gnathopods.

The fifth joint is uniformly shorter than the sixth, which in the fifth pair is considerably elongated, being as long, though not as broad, as the third joint.

The fixed inner branch of the uropods has two or three tubercles on its upper surface; the outer branch is fringed with setæ along the inner margin and has the outer divided into six or seven teeth.

The colouring (as preserved) is a symmetrical dark-grey mottling on a pale ground.

The specimen figured was 9 millims. long and 5 millims. broad. The second pleopods showed no trace of a male appendix.

Numerous examples were obtained at Jokkenpiddi Paar, one in tow-net gathering at Marichchukaddi, two at Cheval Paar, one in Galle Harbour, and one elsewhere.

The tuberculation of the dorsal surface is not incapable of being regarded as forming a series of transverse lines, but the general effect produced is that of a striking contrast between longitudinal lines on the telsonic segment and transverse lines on the rest of the body. I name this prettily sculptured species in honour of A. O. Walker, Esq., F.L.S., a carcinological colleague whose cheering friendship I have for many years enjoyed.

Cilicæa, Leach.

1818, **Cilicæa**, Leach, 'Dictionnaire des Sciences Naturelles,' vol. 12, p. 342 ("*Cilicée*," p. 341).
1818, **Næsa** (part), Say, 'Journ. Acad. Sci. Philad.,' vol. 1, p. 482.
1825, **Cilicæa**, Desmarest, 'Consid. gén. Crust.,' p. 295 ("*Cicilæa*," p. 442).
1829, **Cilicæa**, Latreille, 'Le Règne Animal,' vol. 4, p. 138.
1836, **Cilicæa**, Guérin, 'Iconogr. Règne Animal, Crust.,' pl. 30.
1840, **Nœsea** (part), Milne-Edwards, 'Hist. Nat. Crust.,' vol. 3, p. 216 ("*Nesea*," p. 628).
1853, **Nesæa** (part), Dana, 'U.S. Expl. Exp.,' vol. 13, p. 749.
1879, **Nesea**, G. M. Thomson, 'Trans. New Zealand Inst.,' vol. 11, p. 234.
1881, **Cilicæa**, Haswell, 'Proc. Linn. Soc. N.S. Wales,' vol. 5, p. 475.
1882, **Cilicæa**, Haswell, 'Proc. Linn. Soc. N.S. Wales,' vol. 6, p. 1.
1882, **Cilicœa**, Haswell, 'Catal. Australian Crust.,' p. 295.
1884, **Cilicæa**, Miers, 'Zool. of the "Alert,"' p. 308.
1886, **Cymodocea**, Beddard, '"Challenger" (Isopoda) Reports,' vol. 17, p. 145.
1891, **Cymodocea**, Ives, 'Proc. Acad. Sci. Philad.,' pp. 188, 194.
1899, **Cilicæa**, H. Richardson, 'Proc. U.S. Nat. Mus.,' vol. 21, pp. 831, 838.
1900, **Cilicæa**, H. Richardson, 'The American Naturalist,' vol. 34, No. 399, p. 222.
1900, **Cilicæa**, Stebbing, Willey's 'Zoological Results,' pt. 5, p. 643.
1901, **Cilicæa**, H. Richardson, 'Proc. U.S. Nat. Mus.,' vol. 23, pp. 532, 535.
1902, **Cilicea**, H. F. Moore, 'Bull. U.S. Fish Comm.,' vol. 20 (for 1900), p. 172.
1902, **Cilicæa**, H. Richardson, 'Trans. Connect. Acad.,' vol. 11, p. 291.
1902, **Cilicœa**, Whitelegge, 'Mem. Australian Mus.,' Mem. 4, p. 265.

To include the numerous species now assigned to this genus, the following definition is offered:—

Sexual dimorphism conspicuous. Segments of peræon devoid of dorsal processes. Telsonic segment with an apical sinus. Maxillipeds with fourth, fifth, and sixth joints

produced into apically setose lobes. Gnathopods without fringes of long plumose setæ. Uropods of male (except in *C. spinulosa*) having only the outer ramus strongly developed.

LEACH having only *C. latreillii* on which to found his genus, availed himself of characters which would exclude many of the forms now grouped under this generic name. The four marks which he used for distinguishing *Cilicæa* among the Sphæromidæ were: first, the approximate equality of the sixth and seventh segments of the peræon; second, the prolonged medio-dorsal process on the anterior division of the pleon; third, the apical sinus with central lobe in the hinder division of the pleon; and fourth, the rudimentary character of the inner ramus of the uropods. The second of these characters is conspicuous in fewer than half the species at present assigned to the genus.

The lobe within the apical sinus of the pleon is found in only four of the species, and the fourth character is subject to one curious exception, since in *C. spinulosa* the inner ramus of the uropods is rather longer than the outer. LEACH himself evidently suspected that the long process of the pleon might be peculiar to the male, and this has proved to be the case. But the females, so far as is known, besides being without the dorsal process, have the apical sinus, at least usually, simple, and the rami of the uropods subequal. WHITELEGGE, however, says that "the sexual differences in *C. hystrix* are very slight," and that in *C. stylifera* "the female does not differ materially from the male." He thinks it highly probable that the form figured by HASWELL as the female of *C. hystrix* may really be the female of *C. spinulosa*, HASWELL in his text leaving the point ambiguous. MIERS regards *Sphæroma pubescens*, MILNE-EDWARDS, the *Cymodocea pubescens* of HASWELL, as with scarcely any doubt the female of *C. latreillii*. H. F. MOORE explains *Cymodocea bermudensis*, IVES, as female of *C. caudata* (SAY), and suggests that *Dynamene nodulosa*, RICHARDSON, is the female of *C. caudata-gilliana*, RICHARDSON, *nodulosa* being apparently named by a slip of the pen instead of *tuberculosa*. But S. J. HOLMES makes it fairly certain that *Dynamene tuberculosa* is the female of *Cilicæa cordata*, RICHARDSON. As *tuberculosa* has page precedence, it will supersede *cordata*, and not without advantage to the genus, since to many ears *cordata* and *caudata* are indistinguishable. The confusion caused by the sexual dimorphism in this genus will not, perhaps, be very easily disentangled.

The following synoptic view of the species rather suggests that, for practical convenience, those which are devoid of the great dorsal process might be grouped under a separate generic name:—

1 { Anterior division of pleon in male with long medio-dorsal process—2.
Anterior division of pleon in male without such process—11.

2	Apical sinus in male with prominent central lobe—3.	
	Apical sinus in male with central lobe very small or absent—5.	
3	The medio-dorsal process with apex simple.	1. *C. latreillii*, LEACH, 1818.
	The medio-dorsal process with apex bifid—4.	
4	Outer ramus of uropods sub-apically notched.	2. *C. crassa*, HASWELL, 1882.
	Outer ramus of uropods not notched.	3. *C. longispina*, MIERS, 1884.
5	Apical sinus of pleon in male with very small central lobe.	4. *C. antennalis*, MIERS, 1884.
	Apical sinus of pleon in male without central lobe—6.	
6	Surface of peræon conspicuously spinulose—7.	
	Surface of peræon smooth or moderately granular—8.	
7	Inner ramus of the uropods in male not shorter than the outer.	5. *C. spinulosa*, HASWELL, 1882.
	Inner ramus of the uropods in male shorter than the outer.	6. *C. hystrix*, HASWELL, 1882.
8	Apex of medio-dorsal process not distinctly bifid—9.	
	Apex of medio-dorsal process distinctly bifid—10.	
9	Apex of medio-dorsal process truncate, slightly indented.	7. *C. caniculata* (THOMSON), 1879.
	Apex of medio-dorsal process truncate, slightly trifid.	8. *C. granulata*, WHITELEGGE, 1902.
10	Outer ramus of uropods in male with bifurcate apex.	9. *C. tenuicaudata*, HASWELL, 1881.
	Outer ramus of uropods in male with simple apex.	10. *C. whiteleggei*, n. sp., 1905.
11	Apical sinus of pleon in male with minute central lobe.	11. *C. sculpta* (HOLMES), 1904.
	Apical sinus of pleon in male with large central lobe—12.	
	Apical sinus of pleon in male without central lobe—13.	

12	Central lobe with the flanking apices bifid.	12. *C. granulosa*, H. RICHARDSON, 1899.
	Central lobe with the flanking apices simple.	13. *C. linguicauda*, H. RICHARDSON, 1901.
13	Apical sinus in male simple—14.	
	Apical sinus in male sculptured—17.	
14	Apical sinus visible from above—15.	
	Apical sinus dorsally concealed—16.	
15	Movable ramus of uropods in male stiliform.	14. *C. stylifera*, WHITELEGGE, 1902.
	Movable ramus of uropods in male uncinate.	15. *C. carinata*, H. RICHARDSON, 1900.
16	Apical sinus concealed by a trilobed process.	16. *C. curtispina*, HASWELL, 1882.
	Apical sinus concealed by a simple acute process.	17. *C. ornata*, WHITELEGGE, 1902.
17	Apical sinus with two teeth in the border.	18. *C. beddardi*, n. sp., 1905.
	Apical sinus with four teeth in the border.	19. *C. caudata* (SAY), 1818.
	Apical sinus with six teeth in the border—18.	
18	Teeth in the sinus boldly cut.	20. *C. tuberculosa* (H. RICHARDSON), 1899.
	Teeth in the sinus minute.	21. *C. gilliana*, H. RICHARDSON, 1899.

In regard to this list it should be mentioned that MIERS treats HASWELL'S *C. crassicaudata* and his own *C. longispina* as two varieties of *C. latreillii.* The specific name of *C. antennalis* he adopts from WHITE, who published it in 1847 without a description. The species described by G. M. THOMSON, in 1879, as *Nesea caniculata* was recorded by THOMSON and CHILTON, in 1886, as *Næsa canaliculata*, with a notice that MIERS supposed it to belong to *Cilicæa*, and that the type specimen had apparently been lost. Miss RICHARDSON'S *C. gilliana* was described by her under the name *C. caudata gilliana*, as a new sub-species of *C. caudata* (SAY). Species that may belong to the genus, but which have as yet only been described in the female form, are not included in the list.

Cilicæa latreillii, LEACH—Plates III. (B), VIII.

1818, **Cilicæa latreillii**, LEACH, 'Dict. Sci. Nat.,' vol. 12, p. 342.
1825, **Cilicæa latreillii**, DESMAREST, 'Consid. gén. Crust.,' p. 296, pl. 48, fig. 3.
1836, **Cilicæa latreillii**, GUÉRIN, 'Iconogr. Règne Animal,' pl. 30, fig, 4 (by error marked 2 on plate; see explanation of plates, p. 32, second edition).
1840, **Nœsea latreillii**, MILNE-EDWARDS, 'Hist. Nat. Crust.,' vol. 3, p. 218.

1881, **Cilicæa crassicaudata**, Haswell, 'Proc. Linn. Soc., N.S. Wales,' vol. 5, p. 475, pl. 17, fig. 3.
1884, **Cilicæa latreillei**, Miers, 'Zool. of the "Alert,"' p. 308, var. *crassicaudata*, p. 309.
1902, **Cilicœa crassicaudata**, Whitelegge, 'Mem. Austral. Mus.,' Mem. 4, p. 273, fig. 35.

Male.—Miers says, "the segments of the body are covered with a very short stiff pubescence." In the Ceylon specimen the integument is clothed with plumose setules accompanied by thin pellucid undulating fringes, the precise character of which is not easy to determine. Their function may be to retain a concealing coverlet of mud on the animal's coat, as suggested by Doflein ('Brachyura of the "Valdivia,"' p. 203), for the "leaf-hairs" of the Dromiacea and Oxyrrhyncha. The hind region of the last three peræon segments is ornamented with transverse rows of small granules. The long unsutured side-plates of the first segment have the narrowly-squared front apex commonly found in this and some other genera. In contrast to these, the side-plates of the next three segments are extremely short, those of the third segment ending acutely, with the points less produced than those of their neighbours on either side. The anterior division of the pleon projects a thick, apically obtuse, medio-dorsal process over and beyond the telsonic segment, leaving exposed to view the pair of sub-lateral bosses on that segment, but covering both the central lobe and the sides of its apical notch.

The first antennæ in the specimen figured have a flagellum of twenty-one joints. The second antennæ in the same specimen show a want of symmetry, in one member of the pair the fourth and fifth joints of the peduncle being considerably longer than any of the preceding joints, the flagellum ten-jointed, shorter than the peduncle, while in the other member the fourth and fifth joints of the peduncle are each shorter than the second, and the flagellum is twelve-jointed, longer than the peduncle. Normally, as shown by another specimen, and in Desmarest's figure, the first antennæ are not, as in this instance, longer, but shorter than the second.

Mandibles with dark horn-coloured cutting edge with dentation obscure, accessory plate bidentate on one mandible, simple on the other, a tuft of spines between this and the prominent molar, palp slender.

Maxillipeds: The second joint has a sinuous outer margin to the stem, its plate is of moderate breadth, and the ultimate joint of the palp reaches well beyond the lobe of the penultimate joint.

First gnathopods: Third joint elongate, hind margin carrying many little groups of spinules, front distally channeled and above the groove produced into an obtuse spine-tipped process, fourth joint broader than long, its spine-tipped front apex overlapping the fifth joint, with seven spines along the hind margin; small fifth joint with five, and sixth joint with six spines along the hind margin, of the last set the sixth being shorter than the one before it, but with this exception, the three successive sets of slightly serrate spines beginning with smaller and ending with larger forms. The finger is strong, as long as the stout sixth joint, ending in two horny nails, of which the short inner one is serrate on its inner margin.

The second gnathopods are less robust, the spines of the front margin more developed, those of the hind margin more numerous, but for the most part not so strong, the fifth joint not differing greatly in size and character from the fourth, the finger not quite so long as the sixth joint, and its inner nail showing no serration.

The fifth peræopod is the longest of the limbs, the process of the third joint by successive reduction in prominence here almost disappearing, the fourth, fifth, and sixth joints attaining their greatest elongation, and the finger being decidedly shorter than the preceding joint.

The first pleopods exhibit an interesting feature of the inner branch in that its inner margin, instead of joining the outer either by a continuous straight line or a convex curve, here makes a slightly concave sweep from the point where the fringe of long, feathered setæ begins. The second pleopods, as already described and figured by Mr. Whitelegge, are remarkable for the great length and corrugated appearance of the male stilet. This in our specimen, as in that described by Mr. Whitelegge, was stiffened into a strongly bent position. The three following pairs have the covering branch sutured and lying very close to the branchial plate. In the fifth pair the short, but broad, portion beyond the suture is bilobed, and from the junction of the lobes rises a forward-pointing lappet, this, with the border of the inner lobe, and two tubercles just in advance of the suture, being also closely beset with little teeth or prickles in regular arrangement.

The uropods have the short stout peduncle produced on the inner side to a short thick process representing the inner ramus, of which the appearance varies considerably with the point of view. The stout, blunt outer ramus has a tooth on the outer margin at some distance from the apex, often obscure, and, according to Miers, occasionally obsolete.

Length, 11 millims. to 13 millims. From the tendency of the specimens to fold up, the exact length is not very easily measured.

Localities :—South of Manaar ; Coral reef, Gulf of Manaar ; Pearl banks, Palk Bay. One specimen was obtained at each station.

Cilicæa latreillii, Leach, juv.—Plate III. (B).

This small specimen is remarkable for its coat. This may be described as thickly beset with short, stiff, irregularly blunt setæ covering all the dorsal surface, except such parts as are adapted for sliding under neighbouring parts. In the 'Zoology of H.M.S. "Alert,"' pp. 308–310, 1884, Mr. E. J. Miers makes *Sphæroma pubescens*, Milne-Edwards, 1840, doubtfully, a synonym of *Cilicæa latreillii*, and Haswell's *Cymodocea pubescens*, 1881, with conviction, another synonym. His remarks on the variations of this species according to age, sex, and individuality, should be carefully studied by anyone interested in the subject. Haswell gives the length of his longest specimen of *Cymodocea pubescens* as 1 inch. That the setose covering should be worn down in large specimens might be easily explained, but it is

less easy to understand in an evidently young specimen, such as that in the present collection. Probably, therefore, the peculiar setæ are not stumps due to attrition, but an inchoate stage of the undulating fringes noticed above. It will be observed that the spines of the first gnathopod are not blunted, and the finger clearly shows a delicate serration of the inner margin and small setules on the outer. In the adult male the serration is less easy to observe, the finger having become thicker and coarser.

Length 6 millims., breadth 3 millims.

Locality :—Coast of Ceylon, under 100 fathoms.

Cilicæa whiteleggei, n. sp.—Plate IX. (A), (B).

Male.—This species is easily distinguished from *C. latreillii* by its much slighter general structure, as well as by the character of the very elongate dorsal process in the front division of the pleon, the terminal part of which is not conical but almost parallel-sided and sharply bifid at the apex. Also, the apical notch of the telsonic segment is simply semicircular without median lobe. The three species which make a nearer approach are *C. tenuicaudata*, HASWELL, distinguished by the bifid apices of the uropods ; *C. caniculata* (G. M. THOMSON), with practically truncate apex to the dorsal process and the free ramus of the uropods short and thick ; and lastly *C. granulata*, WHITELEGGE, which also has the dorsal process truncate, " with three small terminal subspiniform granules." This last species attains a length of 13 millims., therefore greatly exceeding in size that which I am here naming after Mr. WHITELEGGE out of respect for his useful researches in this group.

The surface is very inconspicuously granular and hairy, only on the pleon and uropods showing these characters at all distinctly. The side-plates are similar to those of the preceding species, but having in addition a subcarinate appearance along the upper portion. The pleon, which is as long as head and peræon combined, has a rounded tooth or projection on either side of the dorsal process at its base, which must be regarded as an additional distinction between this species and *C. granulata*. It has " a submedian pair of tubercles transversely disposed behind the middle of the terminal segment," such as WHITELEGGE considers distinctive of the female in his species.

The first antennæ have the flagellum consisting of ten or eleven unequal joints, with sensory filaments on the last five. The longer second antennæ have the last joint of the peduncle decidedly longer than the penultimate, the flagellum longer than the peduncle, fifteen-jointed.

In the mouth organs it was probably a casual abnormality that the first maxilla had only three setæ instead of the usual four on the inner plate.

The maxillipeds differ from those of *C. latreillii* by the stronger stem of the second joint, which has a straight outer margin and carries a much wider plate ; also the lobes of the fifth and sixth joints are longer than in the older species.

First gnathopods : The third joint projects and carries a spine at the middle of

the front margin, but has no process. The fourth joint has a spine at the front apex and three on the hind margin, the small triangular fifth has two spines, and the sixth three on the hind margin; the finger has a horny principal nail, but the accessory nail is only represented by a small pellucid spine.

The second gnathopods have similar fingers, but the four preceding joints more elongate, the fifth joint being of the same character as in the peræopods. Most of these limbs show a fur-like clothing of the inner margin of the fourth and two following joints; the spines are quite small and not very numerous; the proportions of the joints are variable, in the long fifth peræopods the fourth joint being as long as the third or the sixth and a little longer than the fifth.

The first pleopods have the inner branch triangular with no distal emargination of the inner border. Both branches are covered with scale-like markings. The male appendix of the second pair is produced only a little way beyond the branches and is subapically widened but apically narrowed to a short obtuse point, thus differing from the longer, not subapically widened stilet in *C. granulata*. The third pleopods differ from those of *C. latreillii* by having the inner branch considerably shorter than the outer, and the part of the outer branch below the suture with a breadth much less in excess of its length.

The uropods have a dorsal tubercle on the peduncle; the peduncle is widened above on the inner side, and is still more widened below into the short unjointed inner ramus. The outer ramus is very long and nearly straight, the tolerably acute tip tending to bend outwards.

Length at full stretch from front of head to end of dorsal process of pleon, 8·5 millims. The uropods reach little beyond the dorsal process.

Localities:—Cheval Paar, Gulf of Manaar; deep water off Galle; off Foul Point, Trincomalee, Station XXIV.

Female.—The form which I regard as the female of this species is devoid of the long dorsal process and has the rami of the uropods subequal. It is also considerably smaller than the male. But in other respects the agreement between the two forms is so close as to leave little room for doubt that they are the same species. The maxillipeds are especially characteristic. The antennæ, first gnathopods, and fifth peræopods, as will be seen by the illustrative figures, are in close agreement. The pleopods, in addition to agreement in shape, show the same scale-like markings.

The uropods have the fixed branch squarely truncate, the outer narrowly ovate, with its apex acute, turned slightly outward. The front division of the pleon has a faintly marked medio-dorsal projection of its hind margin. The telsonic segment has two prominent submedian bosses and a semicircular apical notch.

Localities:—Trincomalee, Station XXIV., off Foul Point; deep water off Galle.

Cilicæa beddardi, n. sp.—Plate X. (A), (B).

Male.—This species is nearly related to *C. caudata* (Say), but, according to the

more recent descriptions and figures of the latter by IVES ('Proc. Ac. Sci., Philad.,' 1891, pp. 188, 194, pl. 6, figs. 11–16), and by H. F. MOORE ('Bull. U.S. Fish. Comm.,' vol. 20 for 1900, p. 172, pl. 10, figs. 5–8, 1902), the present form must be considered distinct. SAY, in his original account, speaks of the telsonic segment as "marked by a deep sinus, within which are two or four small teeth." IVES, who had six male specimens from Bermudas, takes no notice of the alternative two teeth, but says, "there appears to be a tendency in the four spines within the sinus of the posterior abdominal segment to become double." MOORE says, "the apical notch is furnished with four teeth, two small ones at the base, and two larger ones outside of them and at a slightly lower level. The two limbs forming the borders of the notch are notched at their tips and furnished with a tuft of setæ." These notches at the tips are also very clearly shown in the figure given by IVES. In the Ceylon species there are decidedly only two teeth within the sinus, and the tips of the sinus are not notched, but carry dorsally an upright tuft of setules seemingly seated on a tubercle.

A few setules rise from the dorsal surface throughout the length of the animal. There is little difference in length between the segments of the peræon, except in regard to the seventh, which is the shortest, and has its side-plates rounded, less produced than the rest. The anterior division of the pleon has a transverse row of five small setulose tubercles. To these succeed on the telsonic segment three longitudinal ridges divided into tubercles, some of which carry setules. Behind the ridges the segment is depressed and has a group of setules in advance of the sinus which has been above described.

The first antennæ have an eight-jointed flagellum. In the second antennæ one member had the flagellum ten-jointed, while in the other it was seven-jointed.

The epistome is conspicuously tri-lobed above. The distal margin of the upper lip is evenly convex.

One of the mandibles has both cutting edge and accessory plate tri-dentate. On the other the dentation of these parts is obscure. They are succeeded by a bunch of spines. The molar is well developed; the palp slender, with its first joint not much longer than the second or third.

The first maxillæ have the usual four feathered setæ on the inner plate, the apical spines of the outer plate slender.

The maxillipeds are slightly constructed, with the last four joints apically setiferous, the three preceding the terminal joint being produced into narrow lobes.

The limbs are very similar to those of *Cilicæa whiteleggei*, but rather less robust. The second peræopod on the right side of the specimen figured has the sixth joint reduced to an oval stump, carrying no finger.

The first pleopods are remarkable for having the inner ramus twice as broad as it is long, agreeing with the same appendage as described by WHITELEGGE for *Zuzara emarginata*, HASWELL. The second pleopods also have the inner ramus much

broader than long, with the male appendix a little longer than the breadth of the ramus, transparent, smooth, of uniform width, with the apex turned a little away from the ramus. The outer ramus has the serration of its distal outer margin produced into prominent teeth. The third pleopods have the portion of the outer ramus beyond the suture nearly as long as it is broad. The fourth and fifth pairs have branchial folds on both rami.

The uropods are very hairy. The short peduncle is produced into a quadrate process representing the inner ramus, which has its lower angle a little acutely produced and beset with short feathered setæ. The movable ramus is long, cylindrical, slightly curved, the outer margin being convex.

Length 5 millims., breadth 2·5 millims.

Locality :—Cheval Paar; Muttuvaratu Paar.

Cilicæa (?), sp. juv.—Plate IX. (C).

The small specimen figured is no doubt immature, as may be judged from the unfurnished condition of the maxillipeds. The pleon differs little from that of the female or young *C. whiteleggei*, except that the outer ramus of the uropods shows no outward curving. The first antennæ have a massive peduncle and a flagellum of eight joints or, perhaps, more. The flagellum of the second antennæ is twelve-jointed. In the finger of the gnathopods the little spine or tooth at the base of the nail is comparatively strong.

Length, in a somewhat bent position, about 5·5 millims.

Locality :—Palk Bay.

Cymodoce, Leach.

1814, **Cymodoce**, Leach, 'Edinburgh Encycl.,' vol. 7, p. 433.
1902, **Cymodoce**, Stebbing, 'South African Crustacea,' part 2, p. 73.
1904, **Cymodoce**, Stebbing, in Gardiner's 'Fauna, Maldive and Laccadive Archip.,' vol. 2, pt. 3, p. 712.

Cymodoce bicarinata, Stebbing—Plate X. (C).

1904, **Cymodoce bicarinata**, Stebbing, in Gardiner's 'Fauna, Maldive and Laccadive Archip.,' vol. 2, pt. 3, p. 712, pl. 52b.

The specimen here figured differed from the type by its greater proportionate breadth, being 4 millims. broad by 6 millims. long, while the flagellum of the first antennæ was only eleven-jointed, and that of the second fourteen-jointed. But the long genital papillæ* of the seventh peræon segment and the greatly produced inward curving male appendix of the second pleopods and various other features showed close agreement. To judge by other specimens, the breadth is variable.

Milne-Edwards, 'Hist. Nat. Crust.,' vol. 3, p. 213, 1840, describes *C. pilosa* as

* This term is introduced by Dr. H. C. Williamson in the 'Twenty-second Annual Report of the Fishery Board for Scotland,' part iii., p. 101, 1904. For an earlier vague use of it by v. Willemoes Suhm, see '"Challenger" Amphipoda,' p. 438.

follows:—"Body very flexible and almost smooth in front, but granular and setose in the hinder half. Front obtuse as in *Sphæroma*; hind margin of the first pleon segment furnished with two rounded tubercles; two tubercles similar but much larger, more salient and above all more elongated, situated on the last pleon segment and separated by a longitudinal furrow, at the extremity of which is found a boss furnished with a pencil of long setæ. Terminal incision of the pleon very wide; the elongate median process almost cylindrical, rounded at the end, and terminating at the level of the extremity of the two teeth formed by the sides of the incision. Terminal plates of the uropods reaching much beyond the extremity of the pleon; the inner large and obtuse; the outer much broader, thin on the inner side, but very thick towards the outer margin and armed with a conical tooth at its extremity. Length about 6 lines. Habitat, the Mediterranean." A length of 12·5 millims., compared with 6 millims., makes the difference in size very considerable, but in other respects there is a close resemblance between the Pacific species and that described from the Mediterranean.

Localities:—East of Shoal buoy; off Chilavaturai; on trap sunk to bottom, Shoal buoy.

Cymodoce inornata, WHITELEGGE.

1902, **Cymodoce inornata**, WHITELEGGE, 'Mem. Australian Mus.,' iv., pt. 4, p. 263, fig. in text.

The specimen referred to this species agrees well with Mr. WHITELEGGE'S account and figure. It has the body minutely hairy, the pigmented area of the eyes with the narrow end directed backwards, the process in the apical sinus of the telsonic segment small and rounded, the outer ramus of the uropods bidentate, with the outer tooth smaller and higher up than the inner.

On the other hand, it should be stated that the apical sinus is much more marked than that which Mr. WHITELEGGE represents, and the tip of the median process scarcely reaches the level of the apices of the sinus. The outer ramus of the uropods is not so forcibly bidentate as in Mr. WHITELEGGE'S figure, and above the semicircular depression, which that author mentions as extending from one uropod to the other, the telsonic segment is here bilobed. In the Australian memoir it is spoken of simply as convex.

Length about 12 millims., equal to twice the breadth. The specimen was crowded with young ones, in which the eyes were already visible.

Locality:—Coral reefs, Gulf of Manaar. A second specimen was taken south of Adam's Bridge.

TRIBE: VALVIFERA.

To the tribe, in 1897, SARS assigned the three families Idotheidæ (synonymous with Idoteidæ), Arcturidæ (with suggestion of Astacillidæ as the proper substitute), and Chætiliidæ. The late AXEL OHLIN in 1901 added a new family, Pseudidotheidæ, to receive the three species, *Idothea miersii*, STUDER, *Pseudidothea bonnieri*, OHLIN, and *Arcturides cornutus*, STUDER. He was, however, almost convinced that the first

two were identical, and suspected that in any case both would have to be transferred to *Arcturides*, the genus of the third. He recognised that in the latter event the family name would have to be changed. It would rather inconveniently become Arcturididæ. Another family, likewise intermediate between the Idoteidæ and Astacillidæ, is now required. This is remarkable for the negative character in which it agrees with the Amphipoda Caprellidea, a common result being no doubt referable not to any close tie of consanguinity, but to the simple fact that in each instance nature has enabled a species to get rid of limbs for which it had no further use. For the genera *Antarcturus* and *Pseudoprion*, zur Strassen, see 'Zool. Anzeiger,' vol. 25, p. 686; vol. 26, p. 31; 1902–03.

Family: AMESOPODIDÆ, nov.

Body not geniculate, but antennæ, mouth organs, first gnathopods, and appendages of pleon nearly as in the Astacillidæ. Second gnathopods ambulatory, not setose, not fully jointed. First and second pairs of peræopods unrepresented, except by the marsupial plates in the female.

Amesopous, n. gen.

To the characters of the family none can be added for generic distinction, so long as the family contains but a single genus. It may be noticed that the first segment of the peræon is coalesced with the head, that all the segments of the pleon are fused into one, and that the wrist and hand of the first gnathopods are fringed with conspicuously trifid setæ.

The name is framed to express the default of the median pairs of legs. In *Cleantis*, Dana, a genus of the Idoteidæ, which in general facies makes some approach to the present, the second peræopods are the smallest of the limbs. In *Arcturides* the head is only incompletely separated from the first peræon segment, but Ohlin finds this fusion complete in his *Astacilla falclandica*, and nearly so in *A. magellanica*.

Amesopous richardsonæ, n. sp.—Plate XI. (A).

Head united to first peræon segment without apparent suture, rostral point minute, lateral lobes produced about to the end of the first joint of the upper antennæ. Body in male narrowly cylindrical, the limbless segments of the peræon the smallest, but in the ovigerous female the cephalothorax widens distally, and the second, third, and fourth peræon segments which carry large marsupial plates are much wider, the third and fourth being also considerably longer than any of the three following segments. The pleon is narrowly ovoid, narrowly rounded at the apex. In lateral view the dorsal outline is corrugated, and the female has a pair of dorso-lateral tubercles on each of the second, third, and fourth peræon segments.

The eyes are dark, laterally protuberant just below the frontal lobes of the head. The facets are small and numerous.

The first antennæ reach some way along the third joint of the second pair which

they overlie. The first joint is stout, a little longer than broad, the second and third shorter and much narrower, together as long as the one-jointed flagellum, which carries three apical sensory filaments.

The second antennæ have a very short first joint, the second not long, the fifth rather longer than the third and rather shorter than the fourth, the three-jointed flagellum being as long as the peduncle's third joint. The very short apical joint is tipped with a curved spine.

The upper lip appears to be rounded. The lower lip forms two broadly rounded lobes.

The mandibles are without palp, with small tridentate cutting plate and narrow accessory plate, close to which is a strong but not elongate molar with finely denticulate crown.

The first maxillæ show only two plumose setæ on the apex of the inner plate, and nine not very elongate spines on that of the outer plate.

The second maxillæ are remarkably short, with short comparatively broad plates, the outermost tipped with two long setæ, the middle one with four that are not so long, and the innermost with five that are shorter and more spine-like.

The maxillipeds have the lobe of the second joint produced about to the end of the fifth joint and armed on the inner margin with setæ and with three or sometimes only two hooks. The third joint is small, the fifth broadly oval, the sixth much shorter, nearly as broad as long, the seventh almost tubercular; the fifth and sixth are well fringed with setæ on the inner margin. The epipod is quadrately oval in the female, but in the male balloon-like, being very narrow at the base.

The first gnathopods are closely applied to the mouth. They have the fourth joint somewhat cup-like, much broader than the third, the fifth joint longer but not so wide, the sixth narrower than the fifth but subequal to it in length, and both of these notable for the trifid setæ along the inner margin. The middle branch of the setæ is the longest. The narrowed apical part of the sixth joint has curved setæ on the outer margin. The finger is short and conical, and tipped with a spine.

The second gnathopods display only five joints. The finger has its inner margin denticulate and ends in a very small curved unguis, agreeing with the finger in the third, fourth, and fifth peræopods. The two preceding joints have the inner margin denticulate or serrate. Of the four joints preceding the finger the second is not longer than broad, the third is shorter than the first, and the first than the fourth. Whether the first represents a coalescence of the first and second or of the second and third joints, or whether the fourth may be a fusion of the true fifth and sixth joints it is, perhaps, vain to speculate.

The three hinder peræopods are almost exactly alike, the second joint in the female decidedly longer than the sixth, but scarcely so in the male. The third joint is longer than the fourth and the fourth than the fifth.

The first and second pleopods have two slender branches with long apical setæ.

The others appear to be simply branchial, narrowly oval, without setæ. A male pleopod figured shows one of the branches apically divided for a short distance. The smooth inner division is probably the male stilet in preparation.

The uropods are elongate, the narrowly triangular terminal division being about a quarter as long as the peduncle. Within it is a plate about two-thirds as long and half as broad, with a long seta on its rounded apex.

The female is brown, with numerous conspicuous white spots, and three dorsal longitudinal dark bands. The males did not exhibit any white spots, and had two dorso-lateral dark bands.

The length of the female was 6 millims., not including the second antennæ which were 2·75 millims. long. The longest male was 4 millims. From this the detail figures of the male are taken. The male figured measured 2·5 millims. in length. The sex of the female specimen was beyond question, as it was provided with fourteen large eggs. As to the other much smaller specimens one must speak with more reserve, as they might be young ones of either sex.

Locality :—From pearl oysters, East Cheval Paar.

The specific name is given out of respect to the assiduous work which Miss Harriet Richardson has devoted to this tribe of the Isopoda.

Family: IDOTEIDÆ.

Idotea, Fabricius.

1798, **Idotea**, Fabricius, 'Supplementum Ent. Syst.,' p. 302.

Idotea sp.

In a tow-net gathering off Marichchukaddi there were two specimens of a young *Idotea*, 2 millims. long, in which the last pair of peræopods were not yet visible.

Family: ASTACILLIDÆ.

Astacilla, Cordiner.

1795, **Astacilla**, Cordiner, 'Remarkable Ruins . . . and Singular Subjects of Natural History.' Section, "Astacillæ," etc.

1893, **Astacilla**, Stebbing, 'History of Crustacea,' p. 370.

1897, **Astacilla**, Sars, 'Crustacea of Norway,' vol. 2, p. 87.

1904, **Astacilla**, Norman, 'Ann. Nat. Hist.,' ser. 7, vol. 14, p. 447.

Astacilla amblyura, n. sp.—Plate XI. (B).

The head has a minute rostral point and the usual broad lateral lobes in advance of the dark protuberant eyes; it is rather gibbous between the eyes and apparently has a pair of tubercles wide apart in advance of the hump. The specimen was rather foul with adhesive extraneous matter, by which the excrescences were in part obscured, in part exaggerated, and there was some risk, in clearing away what was adventitious,

of removing what really belonged to the animal. A strong groove (but not necessarily an articulation) separates the first segment of the peræon from the head. The long fourth segment has a dorsal hump in advance of the middle and a small medio-dorsal tubercle closely flanked by two others a little to the rear of it on the hind margin. The sixth peræon segment appears to have two lateral tubercles, the fifth and seventh segments each one such tubercle on either side. No transverse dorsal divisions of the pleon could be discerned, but on each lateral margin there are three projections; to the last and most prominent of these a short obtusely ending apical triangle succeeds, very different from the acute ending of the pleon in the four Norwegian species figured by Professor G. O. Sars, but agreeing with the apex in *A. granulata*, Sars, and *A. marionensis*, Beddard.

The first antennæ are normal, with stout first joint, the second and third successively narrower, the one-jointed flagellum fringed with thirteen or fourteen sensory filaments.

The second antennæ are very little shorter than the body, the third joint much stouter distally than at its base, the fourth joint the longest of all, but much narrower than the third and curving to a little conspicuous tooth not far from the base; the fifth joint is narrower, intermediate in length between the third and fourth, about twice as long as the three-jointed flagellum.

In the mouth parts and limbs there is scarcely any tangible difference from the corresponding structures figured by Sars for *A. longicornis* (Sowerby).

On one of the mandibles, between the accessory plate and the strong molar, in this species two or three short spines are to be seen crowded into a very narrow space. The cutting edge has three or four close-set teeth. The first maxillæ have three setæ on the inner plate, nine very short spines on the outer. The second maxillæ have the inner plate much broader and more setose than the other two plates. In the maxillipeds the broad plate of the second joint is armed with a remarkably large coupling hook; the seventh joint is well developed, not unguiform.

The first gnathopods, of which the last four joints are by no means unlike the corresponding four of the maxillipeds, have serrate spines on the broad fifth joint. The seventh joint has one conspicuous spine among many that are smaller. The second gnathopods and the first and second peræopods are, as usual, alike, very slender, with the seventh joint minute, this and the three preceding joints being furnished with very long setæ. The fourth, fifth and sixth joints are subequal in length. The third peræopods are a little longer than the fourth or fifth, all three pairs being stoutly built, with the second and sixth joints longest, but none very elongate or conspicuously armed, except the finger which has a stout apical tooth on the inner margin in addition to the short curved nail. The finger is also tuberculate on the inner margin, and this is perhaps the case with some of the preceding joints.

The pleopods agree very nearly with those which have been figured by Sars for the male of *A. longicornis* and *A. granulata*, the first two pairs having slender rami, with

the setæ of the apical border elongate, and the masculine appendix of the second pair forming a narrow stilet which reaches to the end of the ramus and carries two long apical setæ.

The uropods are rounded above, widest below the middle, then rather rapidly narrowed to the rami, of which the external is very small, acutely triangular, and reaching to the apex of the pleon. The internal ramus is still smaller. Colour in spirit a dull yellowish.

Length 9 millims., apart from the antennæ, the lower of which are nearly as long as the body, about 8·5 millims.

Locality :—Periya Paar, Gulf of Manaar.

A specimen, 4 millims. long, delicately pink in colour, from East Cheval Paar, is no doubt the young of this species. It has the first peræon segment not marked off from the head, the fourth segment very elongate and smooth. The flagellum of the first antennæ is armed about the apex with only three or four sensory filaments. The fifth peræopods are still imperfectly articulated, very small, ending obtusely without a nail.

Another specimen, from East Cheval Paar, is only 3 millims. long, with the fifth peræopods in a still more inchoate condition. Here, however, the fourth segment of the peræon is not especially elongate and shows traces of median and terminal tuberculation. The colour is a delicate pink. Neither in this nor the other juvenile specimen is there a tooth on the fourth joint of the lower antennæ.

The specific name is from the Greek ἀμβλύς, blunt, and οὐρά, tail. Apart from size and arrangement of tubercles, the distinguishing characters of this species depend on the antennal tooth just mentioned, the decided groove between head and peræon, the solidarity of the pleon, and the extension of the uropods further back than appears to be the case in any of the species hitherto described.

Tribe : ASELLOTA.

Family : JANIRIDÆ.

Sars, when separating this family in 1897 from the Asellidæ, incidentally mentioned *Stenetrium* as belonging to the latter. Miss Richardson, in 1902, without comment transferred the genus to the newer division within the Asellota. It certainly seems to conform in many important respects to the following definition which Sars himself gives of the Janiridæ :—

"General habitus that of the Asellidæ, but the lateral parts of the cephalon always lamellarly expanded. Eyes, when present, subdorsal. Superior antennæ sometimes well developed, with the flagellum multiarticulate, sometimes very small, with rudimentary flagellum. Inferior antennæ always longer than the superior, with the peduncle six-articulate, and generally carrying a small accessory appendage (scale) outside the third joint. Oral parts normal. Legs subequal in length, with the dactylus generally bi- or tri-unguiculate ; first pair sometimes differing from the others

in being prehensile. First pair of uropoda [pleopoda] in female transformed into a single, large, opercular plate; in male, constituting the median piece of the compound operculum, the lateral pieces of which are formed by the copulative appendages. The three succeeding pairs very delicate, the last pair forming simple, smooth lamellæ, the two preceding ones with the outer ramus narrow and confluent with the basal part. Uropoda biramous, more or less developed."

From this characterization Miss RICHARDSON's account varies in one or two respects, assigning to the Asellidæ and Janiridæ in common a feature which SARS only attributes to the former, namely, that the first antennæ issue close together, which cannot be predicated of all the Janiridæ, and omitting a feature on which SARS lays stress, namely, that the peduncle of the second antenna is six-jointed. In two species of *Stenetrium* the small fourth joint of this peduncle has been clearly observed, but in three of the species, including the one first assigned to the genus, it is either not present or has been overlooked.

SARS speaks of nine or ten genera as being included in the family, and since he wrote, the genus *Carpias*, RICHARDSON, 1902, has been added. In 1901, Dr. ORTMANN ('Proc. Ac. Philad.,' p. 157) introduced the new generic name *Tole* to take the place of "*Janthe*, BOVALLIUS," on the ground of preoccupation. In this he is followed by Miss RICHARDSON in 1905. But the genus which BOVALLIUS instituted in 1881 is *Ianthe*, not *Janthe*, so that no change is required. Moreover, in his key to the species of *Tole*, the first species which Dr. ORTMANN mentions is "*J. bovallii* (STUDER)," which was named *Ianthopsis bovallii* by BEDDARD in 1886 ('"Challenger" Isopoda,' vol. 17, pt. 48, p. 15, pl. 5, fig. 5). Seeing that Dr. ORTMANN expressly adopts the type species of *Ianthe* as the type of *Tole*, that name must lapse as a synonym, and could not properly be revived in case either *Tole libbeyi*, ORTMANN, or *Tole holmesi*, RICHARDSON, should in future be transferred from *Ianthe* to a distinct genus.

Janira, LEACH.

1814, **Janira**, LEACH, 'Edinburgh Encycl.,' vol. 7, p. 434.
1886, **Janira**, BEDDARD, '"Challenger," Isopoda, Reports,' vol. 17, part 48, p. 5.
1897, **Janira**, SARS, 'Crustacea of Norway,' vol. 2, p. 98.
1898, **Janira**, A. O. WALKER, 'Trans. Biol. Soc. Liverpool,' vol. 12, p. 280.

The species about to be described agrees in many respects with this genus as defined by SARS, but the fifth joint or wrist of the first gnathopods is not subfusiform; it is distally expanded, so as to form a kind of bidentate palm. The single specimen in the collection appears to be an adult male. It was, however, so exceedingly small and defective, having lost most parts of the second antennæ, all the last three pairs of peræopods, and the uropods, that it was not well suited for initiating a new genus. The parallel-sided peræon agrees with what is found in *Jæropsis*, *Stenetrium*, and *Iais*. HASWELL's *Stenetrium inerme* may be congeneric, but the great difference in size makes specific agreement very unlikely.

Janira (?) nana, n. sp.—Plate III. (C).

The general appearance agrees with that of *Jæropsis curvicornis*, in company with which the specimen was taken, but the segments of the peræon are not so markedly separated. The pleon is nearly circular, not serrate, with a small apical convexity, on either side of which the uropods probably protrude.

The eyes are pale orange coloured, differing from those of *Iais pubescens* by having not two but thirty-eight components.

The first antennæ have a stout basal joint, the second much smaller, and the third almost like a flagellar joint; the flagellum is longer than the peduncle, its seven joints unequal in length, all slender, the last tipped with a couple of long setæ or filaments.

The upper lip is rounded, and seemed to be projected forward with the lower lip. The mandibles have a prominent cutting-plate divided into five teeth, the accessory plate on the left similarly divided, but bidentate on the right. The spine-row has five or six spines. The molar is prominent, denticulate. The three joints of the palp are subequal in length. The first maxillæ have a slender inner plate, and nine, mostly denticulate, spines on the outer. The outer and middle plates of the second maxillæ carry each three setæ. In the maxillipeds the plate of the second joint is rather large, with several plumose setæ on the distal margin, and one hook on the inner margin; the third, fourth, and fifth joints are broad, the fifth having its outer margin longer than the inner; the sixth and seventh joints are narrow.

The first gnathopods have the fifth joint much broader but not longer than the sixth, which in closing down would reach much beyond the palmar margin. The finger is much the same in all the known limbs of the peræon, having a short trunk with two distinct nails. The second gnathopods agree with the first and second peræopods in structure, but are longer, especially in the second, fifth, and sixth joints; the sixth joint is narrower than the preceding joint.

The male operculum is composed of the first two pairs of pleopods. The first pair are narrow and more or less tapering, but with a constriction below the middle. They end in two pairs of overlapping shortly lanceolate lobes. The second pair are semicircular, with a long sinuous almost filiform masculine appendix.

Length 1·5 millims. HASWELL'S *Stenetrium inerme* is described as $\frac{5}{16}$ths of an inch in length.

Locality :—Gulf of Manaar.

Jæropsis, KOEHLER.

1885, **Jæropsis**, KOEHLER, 'Ann. Sci. Nat.,' sér. 6, Zool., vol. 19, Art. 1, p. 2.
1886, **Jæropsis**, BEDDARD, '"Challenger," Isopoda, Reports,' vol. 17, p. 20.
1891, **Jæropsis**, CHILTON, 'Trans. New Zealand Inst.,' vol. 24, p. 267.
1893, **Jæropsis**, STEBBING, 'History of Crustacea,' p. 379.
1899, **Jæropsis**, H. RICHARDSON, 'Proc. U.S. Mus.,' vol. 21, p. 857.

1899, **Jæropsis**, NORMAN, 'Ann. Nat. Hist.,' ser. 7, vol. 4, p. 291.
1900, **Jæropsis**, H. RICHARDSON, 'Amer. Naturalist,' vol. 34, No. 400, p. 298.
1902, **Jæropsis**, H. RICHARDSON, 'Trans. Connect. Acad. Sci.,' vol. 11, p. 298.

By the addition, which is well justified, of *Jæra curvicornis*, NICOLET, Miss RICHARDSON is able to say in 1902 that "six species of this genus have been heretofore described." They are *J. curvicornis* (NICOLET); *J. brevicornis*, KOEHLER; *J. marionis*, BEDDARD; *J. neo-zelanica*, CHILTON; *J. lobata*, RICHARDSON; *J. dollfusi*, NORMAN; to which on the same occasion Miss RICHARDSON adds *J. rathbunæ*. *Jæra antarctica*, PFEFFER, may perhaps belong to the group, but the description and figures leave its generic location quite uncertain. All the species have many features in common. They range in size from 2 millims. to a little over 4 millims. The sides of the middle body or peræon are nearly or quite parallel, with the segments very distinctly separated. Both pairs of antennæ are short. The appendages of the peræon are truly isopodous, without any real distinction between gnathopods and peræopods. The uropods are small, carrying two minute dissimilar rami, and occupying emarginations in the distal border of the caudal shield. In the second antennæ the joint numbered second by KOEHLER, third by CHILTON, BEDDARD, and RICHARDSON, fourth by Canon NORMAN, is broadly expanded, unless *J. marionis* be an exception, for in that species the joint is figured as cylindrical rather than laminar.

It may perhaps be objected that there is a want of authority for the statement that the uropods occupy emarginations in the telsonic segment. Miss RICHARDSON indeed says that her species, *J. lobata*, differs from KOEHLER'S "in the shape of the terminal segment, which is perfectly rounded in *J. brevicornis*," while in *J. lobata* "there are two posterior incisions for the reception of the uropods." But one may easily press too far the differences shown in the habitus figures of very minute animals. When the highly magnified figure of the uropod of *J. brevicornis* is considered, it will be noticed that the outer margin is serrate, and this makes it probable that here as in other species it has its share in completing the curve of the tail-piece.

Jæropsis curvicornis (NICOLET)—Plate XI. (C).

1849, **Jæra curvicornis**, NICOLET, in GAY'S 'Hist. fis. y pol. de Chile,' Zool., vol. 3, p. 263, pl. 3, fig. 10.
1891, **Jæropsis neo-zelanica**, CHILTON, 'Trans. New Zealand Instit.,' p. 267.
1902, **Jæropsis curvicornis**, H. RICHARDSON, 'Trans. Connect. Acad. Sci.,' vol. 11, p. 298.

The body, as described by NICOLET, forms a rounded longitudinal medio-dorsal elevation. This is not particularly easy to see, but, when the specimen is placed back downwards, its rolling from side to side is evidence of the shape in question. The head corresponds with CHILTON'S description as being "produced slightly into a rostrum between the bases of the antennæ; end of rostrum emarginate, and with a

rounded lobe fitting into the emargination." NORMAN says of the head in *J. dollfusi* "the anterior margin is emarginate, and in front of this the buccal organs are conspicuously projected," but his figure also shows the rounded lobe in the emargination. The figure of *J. dollfusi* shows the pleon more sharply contracted towards the apex and the sides more deeply serrate than is the case with the present species.

The eyes are not large, not dark, placed near the front angles of the head. The first antennæ have a broad basal joint, seemingly denticulate at the front corners. The second joint is much shorter and much narrower, the third smaller than the second, and the two remaining joints very insignificant, but tipped with two long filaments.

The second antennæ are of the typical form, seemingly with three short basal joints, followed by the characteristic large dilated joint with thin outer margin slightly crenulate, not strongly as in *J. dollfusi;* to this succeeds a much smaller, apically expanded joint, helping to form a double geniculation. The five remaining joints, perhaps, constitute the flagellum, but the first, which is very far the largest of them, has usually been accounted the terminal joint of the peduncle. It is, however, not very usual for the penultimate joint of the peduncle to be shorter than the joint preceding as well as the joint following it.

The upper lip has a rounded distal margin. The mandibles have the cutting edge cut into five teeth, eight spines in the spine-row, the three-jointed palp very small. The first maxillæ have three short spine-like setæ on the inner plate, and nine to eleven spines, mostly denticulate, on the outer plate. The second maxillæ are notable for the shortness of the inner plate; each of the three plates carries four apical setæ. The maxillipeds have a very large second joint with extremely broad plate, the distal margin slightly and irregularly crenulate with a gentle curvature or sinuosity, distinct from the quadrate character displayed in *J. dollfusi.* The coupling hooks are two. The fourth joint is distally produced on the inner margin, the sixth joint is very narrow and the seventh minute.

The limbs of the peræon differ but little, the fourth joint being shorter than the third, fifth, or sixth. The finger has two conspicuous nails and one that is inconspicuous.

The operculum of the pleopods in the female is broadly rounded for nearly two-thirds of its length, and then contracts to a narrowly truncate apex carrying four setules. It does not show marks of a longitudinal or a transverse suture, such as are said by Dr. CHILTON to be indistinctly visible in his specimen.

The uropods fill the emarginations of the pleon. The peduncle is more strongly serrate on the inner than on the outer margin. The inner ramus is hook-like; the outer, which is even smaller than the inner, carries a bunch of setæ.

Length 2 millims. NICOLET gives 2 lines for the length of his specimen; CHILTON about 2·5 millims. for his.

Locality :—Gulf of Manaar.

FAMILY: STENETRIIDÆ *

Stenetrium, HASWELL.

1881, **Stenetrium**, HASWELL, 'Pr. Linn. Soc. N.S. Wales,' vol. 5, p. 478.
1882, **Stenetrium**, HASWELL, 'Cat. of Australian (Malacostracan) Crustacea,' p. 308.
1884, **Stenetrium**, CHILTON, 'Trans. N. Zealand Instit.,' vol. 16, p. 251.
1885, **Stenetrium**, HASWELL, 'Pr. Linn. Soc. N.S. Wales,' vol. 9, p. 1009.
1886, **Stenetrium**, BEDDARD, '"Challenger" Isopoda, Reports,' vol. 17, pt. 48, p. 8.
1895, **Stenetrium**, HANSEN, 'Isopoden der Plankton-Exp.,' p. 6.
1902, **Stenetrium**, H. RICHARDSON, 'Trans. Connect. Ac. Sci.,' vol. 11, p. 295.
1905, **Stenetrium**, HANSEN, 'Proc. Zool. Soc. London,' pp. 303, 316.

Five species have been assigned to this genus, *S. armatum*, HASWELL, *S. inerme*, HASWELL, *S. fractum*, CHILTON, *S. haswelli*, BEDDARD, and *S. stebbingi*, RICHARDSON. But HASWELL'S *S. inerme* differs from his other species in having rounded lateral eyes, the antepenultimate joint of the maxillipeds distally narrowed, and perhaps, also by having the rostrum subacute. It appears to belong to the genus *Notasellus*, PFEFFER, 1887. The union of the other four species in a single genus is probably justifiable, though in each case some important evidence is wanting. For *S. armatum* HASWELL has twice figured the mandible, and on each occasion gives no indication of its possessing a molar. In *S. haswelli*, and in the species about to be described from Ceylon, this part of the mandible is strongly developed and too conspicuous to be overlooked. In the descriptions of *S. fractum* and *S. stebbingi* the presence or absence of this structure is not discussed. For the last-mentioned species no account is given of the pleopods, and for the other species the accounts of these organs are variable or uncertain. Including the new species, which is nearly allied to what is known of *S. fractum*, the genus may be defined as follows:—

Body depressed, parallel-sided. Pleon consolidated. Head bluntly rostrate. Eyes obliquely dorsal. First antennæ short, inserted close to the rostrum on either side of it. Second antennæ elongate, with exopod on the third joint. Mandible with palp. Maxillipeds with third to fifth joints broad, sixth and seventh narrow. First gnathopods simply or complexly subchelate. Second gnathopods and all the peræopods slender, ambulatory, biunguiculate. Pleopods not in every case biramose. Uropods biramose, not adjacent, inserted apically on the telsonic segment.

The uncertainty attending the characters in some of the species makes it difficult to

* After the manuscript of this paper had passed out of my hands, I received the luminous essay, "On the Morphology and Classification of the *Asellota*-group of Crustaceans, with Descriptions of the Genus *Stenetrium*, HASW., and its Species," by Dr. H. J. HANSEN ('Proc. Zool. Soc. London,' p. 302, April 18, 1905). In this the new family Stenetriidæ is defined (*loc. cit.*, p. 315), and nine species of *Stenetrium* are described, with illustrative figures of several and a conspectus of them all. Five are new, *S. mediterraneum*, *S. serratum*, *S. occidentale*, *S. antillense*, *S. siamense*. For a more accurate account of the pleopods than I had myself arrived at I am now indebted to HANSEN'S instructive treatise.

produce a useful synoptic table. The following is offered, therefore, with all necessary reserves :—

	Telsonic segment without lateral notch.	1. *S. haswelli*, BEDDARD.
	Telsonic segment with lateral notch—2.	
2	First gnathopod with hind margin of wrist produced.	2. *S. stebbingi*, RICHARDSON.
	First gnathopod with hind margin of wrist not produced—3.	
3	First antenna, second joint as long as first.	3. *S. fractum*, CHILTON.
	First antenna, second joint shorter than first—4.	
4	Margin of head convex between rostrum and antero-lateral angles.	4. *S. armatum*, HASWELL.
	Margin of head angular between rostrum and antero-lateral angles.	5. *S. chiltoni*, n. sp.

In the adult male the first gnathopods strikingly distinguish *S. haswelli*, *S. stebbingi*, *S. armatum*. But in the female of the last-named species these gnathopods do not appear to differ from those of *S. fractum*, and from those of *S. chiltoni* only by the greater robustness of the hands.

Stenetrium chiltoni, n. sp.—Plate XII. (A).

The whole body, dorsally and at the sides, is beset with rather long stiff setæ. The head has a rather broad, blunt rostrum not reaching so far forward as the broad epistome. The antero-lateral angles of the head are acutely incurved, and between each of these and the rostrum the margin is produced to a point, thus forming sockets for the first antennæ. The segments of the peræon differ but little in length or breadth ; the sides are nearly straight, with the anterior angles of the first four pointing acutely forwards. The telsonic segment has the lateral margins regularly but quite microscopically serrate, and, as in all the species except *S. haswelli*, each of these margins far down is produced into a tooth. The indentation or pocket thus formed is followed lower down by a small setiferous indent, to which succeed the rounded corners of the broad apical margin, with its shallow convex projection between the uropods.

The eyes are narrowly bean-shaped, placed obliquely near the middle of the convex lateral ridges that run below the anterior lobes of the head.

The first antennæ agree closely with those of *S. armatum*, the second joint being much shorter than the first and not so long as the third ; the flagellum is obscurely six-jointed. The second antennæ have the first joint acutely produced on the outer side, but the short second joint and the longer third are not produced on either side. The exopod is conical, having its truncate point tipped with a pencil of setæ. HASWELL has apparently overlooked the second joint and described the third as

produced like the first externally and distally into a slender acute process, the process ending in a hair-like appendage. He does not mention the articulated scale or exopod. For *S. fractum* CHILTON describes and figures the third joint as "produced acutely at its antero-distal angle, bearing on the outer edge an articulated appendage, which has the end rounded and supplied with a few long setæ." The small fourth joint, which is seen in the present species and in *S. haswelli*, is not noticed or figured in connexion with the other three species, as noted in the discussion of the family. The fifth and sixth joints of the peduncle are elongate, the sixth slightly longer than the fifth, the flagellum three times as long as the sixth joint, rather longer than the whole peduncle, composed of very many little scarcely separated joints, setose.

The upper lip is apically rounded. The two broad lobes of the lower lip have the usual armature of minute spines.

Left mandible with dentate accessory plate like the cutting edge but smaller, spine-row of five serrate spines; right mandible without accessory plate, unless it be represented by the first of the five spines in the spine-row; cutting edge with four or five crowded teeth, but within the mandible the new teeth in preparation for the moult are spread out in one plane; molar long and prominent; palp of three long joints, the second carrying five short spines between two long ones, the third falciform, with long spines at apex, short ones fringing the margin.

First maxilla with three spines, a little tooth and some setules on apex of inner plate, and nine more or less denticulate spines on apex of outer plate.

Second maxilla with about four slender spines on apex of outer plate, and also on that of the middle one, the rather broader and more oval inner plate carrying several spines along the inner margin.

Maxillipeds with large distally narrowed epipods reaching nearly to the apical border of the broad lobes which surmount the second joint and considerably overtop the fourth joint; the third joint is short but broad, the fourth larger than the fifth, both of them broad and widened distally, the sixth and seventh being abruptly much narrower.

The first gnathopods have the second joint moderately long, the three following joints short, the fourth subacutely produced on the front margin; the fifth joint is setose on the hind margin; the sixth joint is less than twice as long as its greatest breadth; the front margin is curved and carries a few setules, the hind margin straight, furnished with many setæ; the palm, defined by a long spine, carries several smaller pectinate spines sloping towards this palmar spine; the finger, which curves over the palm and ends in a small simple nail (broken in the specimen), has a few setules on the convex margin and several microscopical spines on the concave border. CHILTON speaks of the palm of his species as "armed with strong serrated setæ," and the finger as having the "inner edge thickly fringed with strong denticulated setæ," but these expressions may refer to the armature as it appears when very highly magnified.

The second gnathopods appear to have a round-lobed first joint; the second joint is

about as long as the third and fourth combined, the third being much longer than the fourth, nearly as long as the sixth, which is slightly shorter than the fifth. The finger is less than half as long as the sixth joint; it curves to a sharp apical point, which is overhung by an unguis-like spine, while on the concave margin of the finger there is a small spine. The peræopods differ little in character from the second gnathopods, except that the second joint is less elongated and the third joint is more nearly subequal in length to the sixth. To the first and second gnathopods and first and second peræopods in one of the specimens four pairs of marsupial plates were attached, the third pair being the largest, but the fourth also of considerable size. In dissection of the pleon there came away a linear ring, which, perhaps, represents a degraded first pleon segment. Dorsally two such segments are indicated.* A small unpaired plate, square above and triangular below, without any trace of longitudinal or other suture, must be regarded as representing the first pair of pleopods.† The second pleopods are wanting, as in other females of this tribe. The third pleopods form a very large pair of biramose appendages, the peduncle small, the inner ramus branchial, with three or four setæ on the narrow apex, the outer ramus of great size, with slightly oblique transverse suture below the middle, but starting just above the apex of the inner ramus. The fourth pair are biramose, and have the oval inner branchial ramus much broader and not shorter than the outer ramus, which shows a transverse suture above the middle and has the tapering lower division fringed with several long setæ. In the fifth pair each pleopod consists of a single branchial ramus, possibly representing a coalescence of two rami, the outer margin raised and distally fringed with setæ.‡

The uropods are inserted a little within the distal margin of the telsonic segment, separated by the convexity which may be considered an equivalent of the actual telson. The peduncle is rather stout, shorter than the rami, of which the inner is the larger, both being well furnished with tufts of long setæ on sides and apex.

Description of the uropods and the complete second antennæ is based on a specimen of the same dimensions as the one figured, but which did not come to light till after the less complete example had been figured. This second specimen was straight, but a third, rather smaller specimen with it had a distortion similar to that shown in the plate.

Length 4·5 millims., breadth 1·5 millims.

Locality :—Reef, Galle, with Ascidians; and Coral banks, Gulf of Manaar.

* For the genus at large HANSEN says, "two rudimentary segments are observed in front of the large abdominal shield" (*loc. cit.*, p. 304).

† HASWELL (*loc. cit.*, p. 1010) says: "The bases of the first pair of abdominal appendages are covered in both cases by a broad plate, with a bifid apex attached to the posterior border of the last thoracic segment." By "both cases" no doubt the two sexes are intended, and "the first pair of abdominal appendages" are really the third pair of pleopods.

‡ HANSEN in his character of the family says in regard to the pleopods, "fifth pair with only one ramus, in all probability the exopod" (*loc. cit.*, p. 315).

The specific name is given out of respect to my friend Dr. CHARLES CHILTON, whose *Stenetrium fractum* has a name only too suggestive of the mishaps to which these delicate isopods are liable. HASWELL's species is described as half-an-inch long, CHILTON's as about a sixth of an inch. Though it remains a little doubtful whether the species here described belongs to HASWELL's genus, the possibility is also open that *S. armatum*, *S. fractum*, and *S. chiltoni* may all be the same species.

FAMILY: MUNNIDÆ.

Pleurocope, A. O. WALKER.

1901, **Pleurocope**, WALKER, 'Journ. Linn. Soc.,' London, vol. 28, p. 297.

Mr. WALKER remarks that "this genus differs from *Pleurogonium*, its nearest ally, in the large size and peculiar appendages of the head, the different relative proportion and structure of the antennæ, in the form of the caudal segment, and in the position and size of the uropods, which are unusually large for the family." It may, however, be observed that in the genus *Dendrotion*, SARS, the uropods are larger and more conspicuous than in the present genus.

Pleurocope dasyura, WALKER.

1901, **Pleurocope dasyura**, WALKER, 'Journ. Linn. Soc.,' vol. 28, p. 297, pl. 27, figs. 12 to 18.

The description by Mr. A. O. WALKER, and the excellent figures by Mr. ANDREW SCOTT which accompany it, place the identification of this species beyond doubt. Beyond verification I have nothing to add, except that the peræon displayed four stiff upstanding dorsal setæ. A point of interest would have been to ascertain the character of the mandibles. But at the very moment when I was arranging the specimen for dissection, it disappeared like a dream, and defied all the efforts made for its re-discovery.

The length was a little over 1 millim., therefore approximately the same as Mr. WALKER's type specimen from the Mediterranean. It came into my hands already named by Mr. A. SCOTT.

Locality:—Gulf of Manaar.

TRIBE: ONISCIDEA.

FAMILY: LIGIIDÆ.

Ligia, FABRICIUS.

1798, **Ligia**, FABRICIUS, 'Supplementum Ent. Syst.,' p. 301.
1885, **Ligia**, BUDDE LUND, 'Isopoda Terrestria,' p. 258.

Ligia exotica, ROUX.

1828, **Ligia exotica**, ROUX, 'Crust. Médit.,' livr. 3, pl. 18, f. 9.
1885, **Ligia exotica**, BUDDE LUND, 'Isopoda Terrestria,' p. 267.

A mutilated specimen occurs in the collection, which appears with little doubt to belong to this widely distributed species.

Locality:—Station XXXIX., Gallehogalle Bank, 16 to 30 fathoms

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EXPLANATION OF PLATES.

PLATE I.

A. *Heterotanais crassicornis*, n. sp.—*n.s.*, natural size of specimen figured in lateral and in dorsal view; *a.s.*, *a.i.*, upper and lower antennæ more highly magnified; *gn.* 1, *gn.* 2, first and second gnathopods; *prp.* 1, *prp.* 3, first and third peræopods; *urp.*, uropod.

All the details are to the same scale, except the separate thumb and finger of *gn.* 1, and the separate outer branch of the uropod, which are more magnified than the other parts.

B. *Leptochelia mirabilis*, n. sp.—*A.n.s.*, natural size of specimen figured in dorso-lateral view, with first gnathopod of the right side supplied from fragments; *gn.* 1, part of first gnathopod of the left side, probably belonging to the above specimen and drawn to the same scale; *a.s.*, *a.i.*, third joint of peduncle and the flagellum of upper antenna, and the lower antenna—these and the following details on a higher scale of magnification; *gn.* 2, *prp.* 5, second gnathopod and part of fifth peræopod; *plp.*, *urp.*, one of the pleopods and a uropod; *B.n.s.*, natural size of specimen figured in dorsal view, showing lower antennæ and base of right upper antenna; uropods broken.

C. *Leptochelia lifuensis*.—*a.s.* ♀, *a.i.* ♀, upper and lower antennæ of female; *gn.* 1, ♀, *gn.* 2, ♀, first and second gnathopods of female; *urp.* ♀, uropod of female; *a.s.* ♂, *a.i.* ♂, upper and lower antennæ of male; *gn.* 1, ♂, first gnathopod of male; *urp.*, uropod of male.

All the above are magnified to the same scale as the general details in Plate I., A, except the separate ramus of the male uropod, which is magnified on the same scale as the corresponding ramus in Plate I., A.

D. *Tanais gracilis*, Heller.—*n.s.*, natural size of specimen figured in lateral and dorsal views; *a.s.*, *a.i.*, upper and lower antennæ very highly magnified; *gn.* 1, *gn.* 2, *prp.* 4, first and second gnathopods and fourth peræopod; *Pl.*, *urp.*, dorsal view of pleon and uropods, to the same scale as the preceding details; *m.*, *mxp.*, mandible and maxillipeds, exopod of the latter detached and incomplete. These and the separate portions of the second gnathopod and fourth peræopod are more magnified than the other details.

PLATE II.

A. *Conilorpheus herdmani*, n. gen. et sp.—*n.s.*, lines indicating natural size of specimen figured below in dorsal and lateral view; *C.*, dorsal view of the head; *Per.s.* 7, seventh segment of peræon in dorsal view, and in lateral view with the fifth peræopod and pleopods showing below; *Pl.*, pleon in dorsal view; *a.s.*, *a.i.*, first and second antennæ; *m.*, *m.*, *mx.* 1, *mx.* 2, *mxp.*, the two mandibles, first and second maxillæ, and maxillipeds, the mandible on the right figured from the inner side; *gn.* 1, *prp.* 4, *prp.* 5, *plp.* 1, *plp.* 2, *urp.*, first gnathopod, fourth and fifth peræopods, first and second pleopods, and uropods, the last in ventral view.

The mouth organs are magnified on a higher scale than the other appendages.

B. *Hansenolana sphæromiformis* (Hansen).—*n.s.*, lines indicating natural size of specimen figured in dorsal view; *Pl.*, pleon in dorsal view; *a.s.*, *a.i.*, first and second antennæ; *m.*, *mx.* 1, *mx.* 2, *mxp.*, mandible, first and second maxillæ, maxillipeds; *gn.* 1, *gn.* 2, *prp.* 5, *plp.* 1, *plp.* 2, *plp.* 4, *urp.*, first and second gnathopods, part of fifth peræopod, first, second, and fourth pleopods, and uropods. Below the full figure of *gn.* 1 from the outside is given a more enlarged figure of the other member of the pair from the inner side. The portion of this *gn.* 1 and the portion of *prp.* 5 are enlarged on the same scale as the mouth organs.

PLATE III.

A. *Argathona normani*, n. gen. et sp.—*n.s.*, lines indicating natural size of the specimen represented by the adjoining figures in dorsal and lateral views; *Pl.*, pleon in dorsal view, more highly magnified; *a.s.*, *a.i.*, the first and second antennæ; *l.s.*, the upper lip, with the epistome surmounted by the frontal lamina; *l.i.*, the lower lip; *m.*, *m.*, the left mandible entire, and part of the right mandible; *mx.* 1, *mx.* 2, *mxp.*, the first and second maxillæ and the maxillipeds; *gn.* 1, *gn.* 2, *prp.* 5, the first gnathopod without side-plate, the second gnathopod and fifth peræopod each with its side-plate; *plp.* 2, the second pleopod.

The mouth parts are magnified on a higher scale than the other appendages, but the uropods figured in attachment to the pleon are enlarged on a lower scale than the rest.

B. *Cilicæa latreillii*, LEACH, juv.—*n.s.*, lines indicating natural size of specimen figured below in dorsal and dorso-lateral aspects; *Pl.*, pleon in dorsal view; *a.s.*, *a.i.*, first and second antennæ; *l.s.*, upper lip with epistome; *mxp.*, maxillipeds; *gn.* 1, first gnathopod.

The mouth parts are more highly magnified than the other appendages.

C. *Janira* (?) *nana*, n. sp.—*n.s.*, line indicating natural size of the specimen; *Pl.*, pleon, without appendages; *a.s.*, *a.i.*, first antenna and four basal joints of second; *l.s.*, *l.i.*, upper and lower lips; *m.*, *m.*, *mx.* 1, *mx.* 2, *mxp.*, the mandibles, first and second maxillæ, and a maxilliped; *gn.* 1, *gn.* 2, *prp.* 1, first and second gnathopods and first peræopod, the finger of the first gnathopod and that of the first peræopod more enlarged; *plp.* 1, *plp.* 2, the first and (one of the) second pleopods, the two pairs together forming the male operculum.

The mouth parts are more highly magnified than the other appendages, being on the same scale as the more enlarged finger of the first gnathopod.

PLATE IV.

Æga ommatophylax, n. sp., ♂.—*n.s.*, lines indicating natural size of the specimen figured in dorsal aspect; *C.*, the head in dorsal aspect; *C.L.*, lateral view of the head in conjunction with the first two segments of the peræon; *Per.s.* 1., anterior part of first segment of peræon in dorsal view; *g.p.*, ventral plate of the seventh peræon segment, with the genital papillæ also more highly magnified; *Pl.*, Pleon in ventral view, after removal of the pleopods; *a.s.*, *a.i.*, first and second antennæ; *m.*, *mx.* 1, *mx.* 2, *mx.* 2, *mxp.*, mandible, first maxilla, second maxilla in two positions, maxillipeds in ventral aspect. These organs are magnified on a higher scale than the other details in general, and the distal parts of mandible, first maxilla, and maxillipeds are again more highly magnified. In the mandible the third joint of the palp is missing. The further enlargement of the maxillipeds is from the dorsal aspect. *gn.* 1, *gn.* 2, *gn.* 2, *prp.* 3, *prp.* 5, *plp.* 1, 2, 5, *urp.*, the first and second gnathopods, third and fifth peræopods, first, second and fifth pleopods, and the uropod. The portions of these appendages which required further enlargement are on the same scale as the principal figures of the mouth organs. Both members of the second pair of gnathopods are figured, to show the difference mentioned in the text.

PLATE V.

A. *Æga ommatophylax*, n. sp., ♀ (?).—*n.s.*, lines indicating natural size of specimen figured above in dorsal view; *C.*, ventral view of the head; *l.s.*, upper lip surmounted by the epistome and frontal lamina; *m.*, *m.*, the two mandibles, with higher magnification of a seta from second joint of palp, and of

apical portion of the trunk. In both mandibles a rounded lobe is shown below the apical margin, but this lobe was only indefinitely made out. *mx.* 1, *mx.* 2, *mxp.*, first and second maxillæ, with the apices more highly magnified, and the maxillipeds.

B. *Lanocira zeylanica*, n. sp.—*n.s.*, lines indicating natural size of specimen figured above in dorsal view; *Pl.*, dorsal view of pleon more highly magnified; *a.s.*, *a.i.*, first and second antennæ; *l.s.*, upper lip; *m.*, *m.*, *mx.* 1, *mx.* 1, *mx.* 2, *mxp.* the mandibles, first maxillæ, one of the second maxillæ, and the maxillipeds; *gn.* 1, *prp.* 5, first gnathopod and fifth peræopod; *plp.* 1, *plp.* 2, first and second pleopods.

The mouth organs are more highly magnified than the other appendages.

PLATE VI.

A. *Rhiothra callipia*, Schiödte and Meinert.—*n.s.*, lines indicating natural size of male specimen figured above in dorsal view; *C.*, the head, stripped of its appendages, in dorsal view; *a.s.*, *a.i.*, the first and second antennæ, with the terminal portion of each more highly magnified; *m.*, a mandible in connexion with the epistome; *mx.* 1, *mx.* 2, *mxp.*, the first and second maxillæ and the maxillipeds; *gn.* 1, *prp.* 5, the first gnathopod and the fifth peræopod; *plp.* 2, the second pleopod, a more highly magnified portion showing the numerous coupling-spines of the peduncle and the male appendix of the inner branch. *urp.*, one of the uropods.

The mouth organs are more highly magnified than the full figures of the other appendages.

B. *Irona nanoides*, n. sp.—*n.s.*, lines indicating natural size of the female specimen figured at the centre in dorsal view; *C.*, the head, stripped of its appendages, in dorsal view; *a.s.*, *a.i.*, the first and second antennæ; *m.*, the mandible in connexion with the upper lip; *mx.* 1, *mxp.*, the first maxilla and a maxilliped; *gn.* 1, *prp.* 5, first gnathopod and fifth peræopod; *plp.*, *urp.*, a pleopod and one of the uropods.

The mouth organs are more highly magnified than the other parts.

C. *Rocinela orientalis*, Schiödte and Meinert.—*n.s.*, lines indicating natural size of specimen figured at the centre in dorsal view; *n.s.* ♂, lines indicating natural size of a full-grown male specimen, from which the figures marked ♂ are taken; *a.s.*, *a.s.* ♂, first antenna of each specimen; *mxp.*, *mxp.* ♂, one maxilliped of the smaller specimen and both maxillipeds of the larger; *gn.* 1, *gn.* 2, *prp.* 5, first and second gnathopods and fifth peræopod from the smaller specimen; *plp.* 2, second pleopod of the full-grown male; *Pl. urp.*, dorsal view of the pleon of the smaller specimen, much of the right side omitted for want of space; *Pl.* ♂, *urp.*, telsonic segment and left uropod of the full-grown male in dorsal view. The unsymmetrical right margin of the segment is seen through the figure of the transparent pleopod placed above it for convenience.

The maxillipeds are more highly magnified than the other parts.

PLATE VII.

Sphæroma walkeri, n. sp.—*n.s.*, *n.s.*, curved line indicating natural size of partially rolled specimen figured above in lateral view, crossed lines showing length and breadth of the same specimen unrolled and figured below in dorsal view; *a.s.*, *a.i.*, first and second antennæ; *l.s.*, epistome and upper lip; *m.*, *m.*, the mandibles, the palp of one separately figured on the right to display relative length of the first joint; *mx.* 1, *mx.* 2, *mxp.*, *mxp.*, first and second maxillæ, and one of the maxillipeds figured from the outer and the inner surface; *gn.* 1, *gn.* 2, the first and second gnathopods, with a more enlarged figure of the terminal part of the first; *prp.* 1, 4, 5, first, fourth and fifth peræopods; *g.sp.*, gastric spines, more highly magnified than the other details, among which the mouth organs are on a higher scale than the antennæ and limbs.

PLATE VIII.

Cilicæa latreillii, Leach.—*n.s.*, outline indicating natural size of specimen figured below in partially bent position and in lateral view; *Pl.V.*, ventral view of the pleon, omitting the pleopods; *Pl.D.*, dorsal view of the pleon with seventh segment of the peræon; *a.s.*, upper antenna; *a.i.*, *a.i.*, both members of the lower pair of antennæ, to show the casual want of symmetry; *l.s.*, upper lip and epistome from the upper (inner) side; *l.i.*, lower lip; *m.*, *m.*, the two mandibles; *mx.* 1, *mx.* 2, *mxp.*, the first and second maxillæ and the maxillipeds; *gn.* 1, *prp.* 5, the first gnathopod and the fifth peræopod; *plp.* 1, 2, 4, 5, the first, second and fifth pleopods, and part of the fourth; *int.*, a small piece of the integument from side-plate of seventh peræon segment.

The antennæ, mouth organs, and limbs in detail are drawn to a uniform scale. The fragment of the integument is more highly magnified.

PLATE IX.

A. *Cilicæa whiteleggei*, n. sp., ♂.—*n.s.*, line indicating natural size of specimen figured above in partially bent position and in lateral view; *C.D.*, dorsal view of head with first two segments of peræon not flattened out; *Pl.D.*, *Pl.V.*, dorsal and ventral views of pleon to the same scale as preceding figure; *mx.* 1, *mxp.*, first maxilla and maxillipeds more highly magnified than the other figures, with one exception; *a.s.*, *a.i.*, *l.s.*, first and second antennæ with epistome and upper lip; *gn.* 1, *prp.* 5, first gnathopod and fifth peræopod; *plp.* 1, 2, 3, *plp.* 2, *m.s.*, first, second and third pleopods, to the same scale as the antennæ and trunk limbs, but the separate male stilet of *plp.* 2 to the same scale as the maxillipeds.

B. *Cilicæa whiteleggei*, n. sp., ♀.—*n.s.*, line indicating natural size of specimen figured above, much bent and in lateral view; *Pl.*, pleon in dorsal view, with last segment of peræon and parts of the two preceding segments; *a.s.*, *a.i.*, first and second antennæ; *mx.* 1, *mxp.*, first maxilla and maxillipeds. These are more highly magnified than the other details, and more highly than the corresponding parts of the male; *gn.* 1, *prp.* 5, *plp.* 1, first gnathopod, fifth peræopod, and first pleopod.

C. *Cilicæa* sp., juv.—*n.s.*, line indicating natural size of specimen figured above, slightly bent, and in lateral view; *mxp.*, maxillipeds magnified to the same scale as those in Plate IX., B; *gn.* 1, *urp.*, first gnathopod and uropod.

PLATE X.

A. *Cilicæa beddardi*, n. sp. ♂.—*n.s.*, line indicating natural size of male specimen figured above in dorsal view; *a.s.*, *a.i.*, first and second antennæ; *l.s.*, upper lip with epistome; *l.i.*, lower lip; *m.*, *m.*, complete mandible on the right of the plate, and on the left the cutting edges and spine-row of its companion; *mx.* 1, *mxp.*, first maxilla and maxillipeds; *gn.* 1, 2, *prp.* 1, 2, 3, 4, 5, the first and second gnathopods and the five peræopods in lateral view, connected together; *plp.* 1, 2, 5, the first, second, and fifth pleopods; *urp.*, uropod.

Of the details, the mouth parts are magnified on a higher scale than the other appendages.

B. *Cilicæa beddardi*, n. sp. ♀.—*n.s.*, line indicating natural size of female specimen figured above in dorsal view and not quite flat. Some of the details are from another female specimen; *juv.*, dorsal view of a young one taken out of the specimen of which the mouth organs and pleon are figured; *a.s.*, *a.i.*, first and second antennæ; *m.*, *l.i.*, *mx.* 1, 2, *mxp.*, mandible, lower lip, first and second maxillæ, and maxilliped, rather more highly magnified than the antennæ and limbs; *gn.* 1, *prp.* 1, first gnathopod and first peræopod; *Pl.*, telsonic segment and uropods.

C. *Cymodoce bicarinata*, STEBBING.—*n.s.*, lines indicating natural size of specimen figured above in dorsal view; *Pl.*, ventral view of pleon, the pleopods removed; *g.*, part of the gastric apparatus; *a.s.*, *a.i.*, first and second antennæ; *l.s.*, *l.i.*, *mxp.*, upper and lower lips and maxillipeds; *gn.* 1, *prp.* 5, first gnathopod and fifth peræopod; *g.p.*, genital papillæ from seventh peræon segment; *plp.* 2, second pleopod, with apical part of male appendix more highly magnified.

PLATE XI.

A. *Amesopous richardsonæ*, n. gen. et sp.—*n.s.* ♀, line indicating length of body and second antennæ of the female specimen figured above in lateral and below in dorsal view; *n.s.* ♂, line indicating length of body of a young, probably male, specimen figured in dorsal view. *C.T.*, *a.s.*, *a.i.*, cephalothorax (head and first peræon segment), with a first antenna and part of the second as far as base of fourth joint; the flagellum shown separately; *l.i.*, *m.*, *mx.* 1, *mx.* 2, *mxp.*, lower lip, a mandible (with part more enlarged), first and second maxillæ, and maxillipeds; *gn.* 1, *gn.* 2, first and second gnathopods. All these details are from the female specimen, the mouth organs more highly magnified than the other appendages. *prp.* 4 ♂, *plp.* ♂, *urp.* ♂, fourth peræopod, second pleopod, and uropod from a male specimen 4 millims. long. The figures drawn to the same scale as that used for the limbs of the female.

B. *Astacilla amblyura*, n. sp.—*n.s.*, line indicating length of body and second antennæ of the specimen figured in lateral view; *C.*, part of head; *Pl.*, dorsal view of pleon, showing one of the valvular uropods thrown open; *a.s.*, *a.i.*, first and second antennæ; *m.*, *mx.* 1, *mx.* 2, *mxp.*, mandible (with part more enlarged), first and second maxillæ, maxillipeds; *gn.* 1, *gn.* 2, *prp.* 5, first and second gnathopods and fifth peræopod, with the finger of each more enlarged; *plp.* 2, *urp.*, second pleopod and uropod.

C. *Jæropsis curvicornis* (NICOLET).—*n.s.*, line indicating length of specimen figured above in dorsal view; *C.*, dorsal view of head, with upper lip and one of the mandibles projecting in front; *Pl.*, ventral view of pleon, without the pleopods; one uropod more highly magnified; *operc.*, opercular plate formed by the first pleopods; *a.s.*, *a.i.*, upper and lower antennæ, with most of the lower antenna more enlarged; *m.*, *m.*, *mx.* 1, *mx.* 2, *mxp.*, the mandibles, first and second maxillæ, and maxillipeds, with the cutting plates of the mandibles and one palp of the maxillipeds more highly magnified; *gn.* 1, *gn.* 2, *prp.* 5, first and second gnathopods and fifth peræopod, with the fingers of first gnathopod and fifth peræopod more enlarged.

All the detail figures are enlarged to the same scale, but are accompanied in some instances by parts more highly magnified.

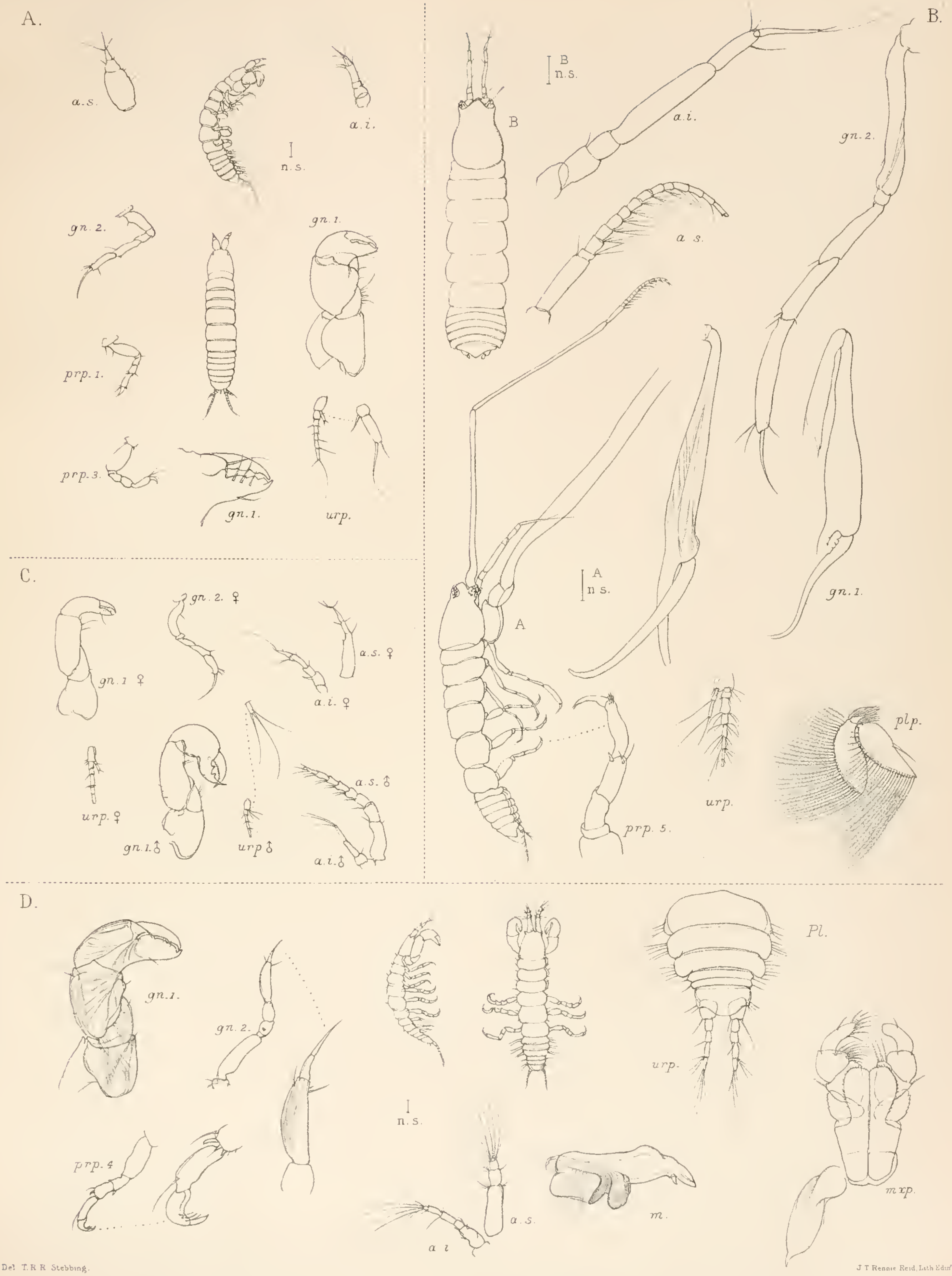
PLATE XII.

A. *Stenetrium chiltoni*, n. sp.—*n.s.*, lines indicating natural size of specimen figured below in dorsal view; *C.*, *a.s.*, *a.i.*, dorsal view of head more enlarged, with the eyes, the first antenna of the left side, part of that on the right, and parts of the second antennæ, ending with the third joint on the left, with the fourth on the right. *Pl.*, terminal part of pleon; this, with the legs and pleopods, is enlarged to the same scale as the preceding figure, while the mouth organs are more highly magnified, and the spines of the first gnathopod still more highly. *l.s.*, *l.i.*, upper and lower lips; *m.*, *m.*, *mx.* 1, *mx.* 2, *mxp.*, *ep.*, mandibles, first and second maxillæ, maxillipeds, with one epipod detached; *gn.* 1, *gn.* 2, *prp.* 1, first gnathopod, with some of the spines of the palm and finger very highly magnified; second gnathopod; first peræopod; *plp.* 1, 3, 4, 5, the first, third, fourth and fifth pleopods; *a.i'.*, second antenna from a different specimen, to which the following parts also belong;

gn. 1′, first gnathopod, showing the marsupial plate; *prp.* 5′, terminal part of fifth peræopod; *urp.*′, the uropods.

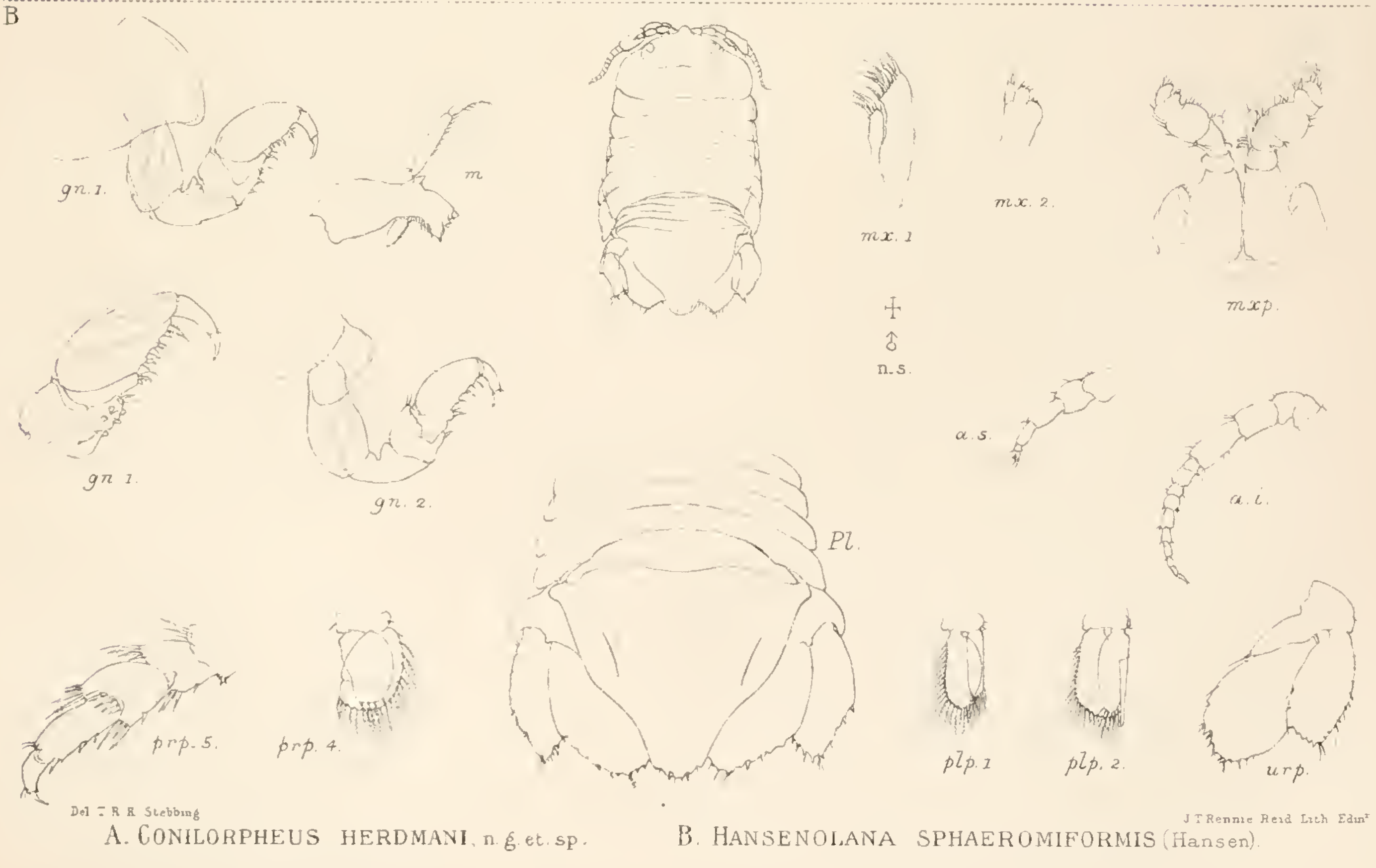
B. *Gnathia insolita*, n. sp.—*n.s.*, lines indicating natural size of specimen figured in dorsal view; *C.*, cephalic region, showing the muscles belonging to the mandibles; *Pl.*, pleon in dorsal view, with rudimentary seventh segment of peræon; *a.s.*, *a.i.*, first and second antennæ; *m.*, *mxp.*, a mandible and the maxillipeds; *gn.* 1, 2, first and second gnathopods; *plp.* 1, *plp.*, first pleopod, and one of the following pairs.

All the details are magnified to the same scale.



Del. T. R. R. Stebbing. J. T. Rennie Reid, Lith. Edin.

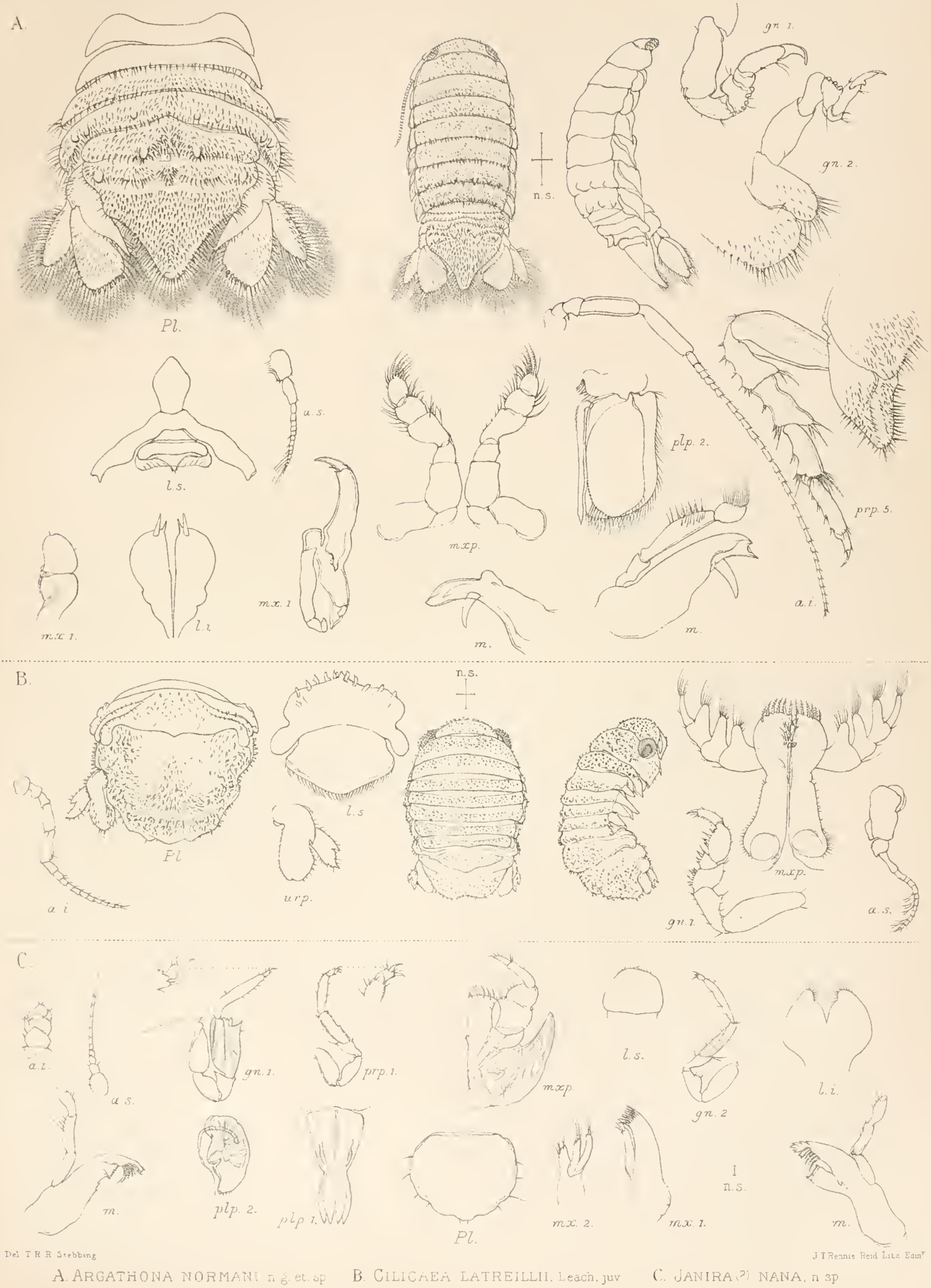
A. HETEROTANAIS CRASSICORNIS, n. sp. B. LEPTOCHELIA MIRABILIS, n. sp. C. L. LIFUENSIS, Stebbing
D. TANAIS GRACILIS, Heller



Del T R R Stebbing

J T Rennie Reid Lith Edin[r]

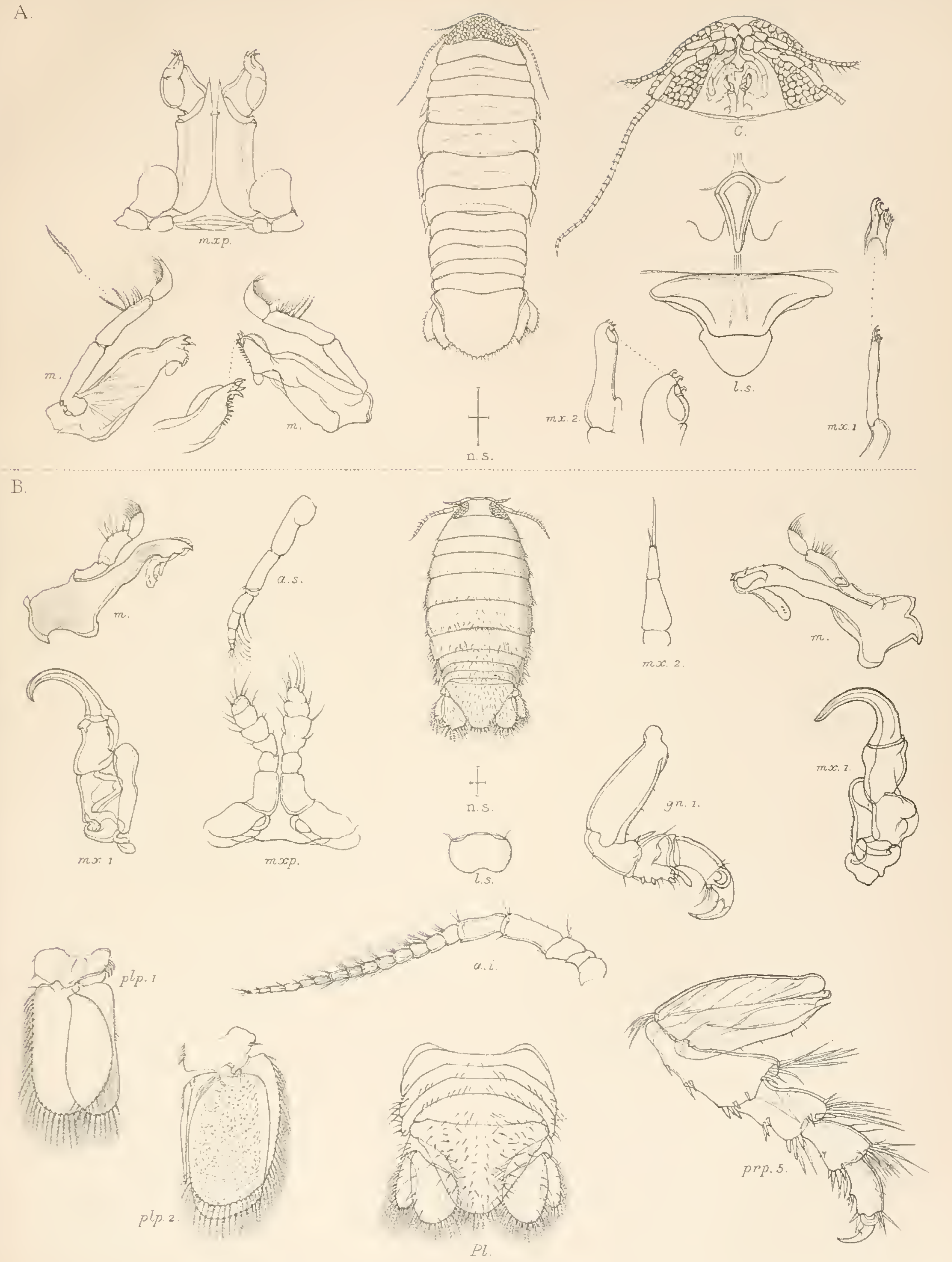
A. CONILORPHEUS HERDMANI, n. g. et. sp.   B. HANSENOLANA SPHAEROMIFORMIS (Hansen).



A. ARGATHONA NORMANI n. g. et. sp. B. CILICAEA LATREILLII, Leach, juv. C. JANIRA (?) NANA, n. sp.

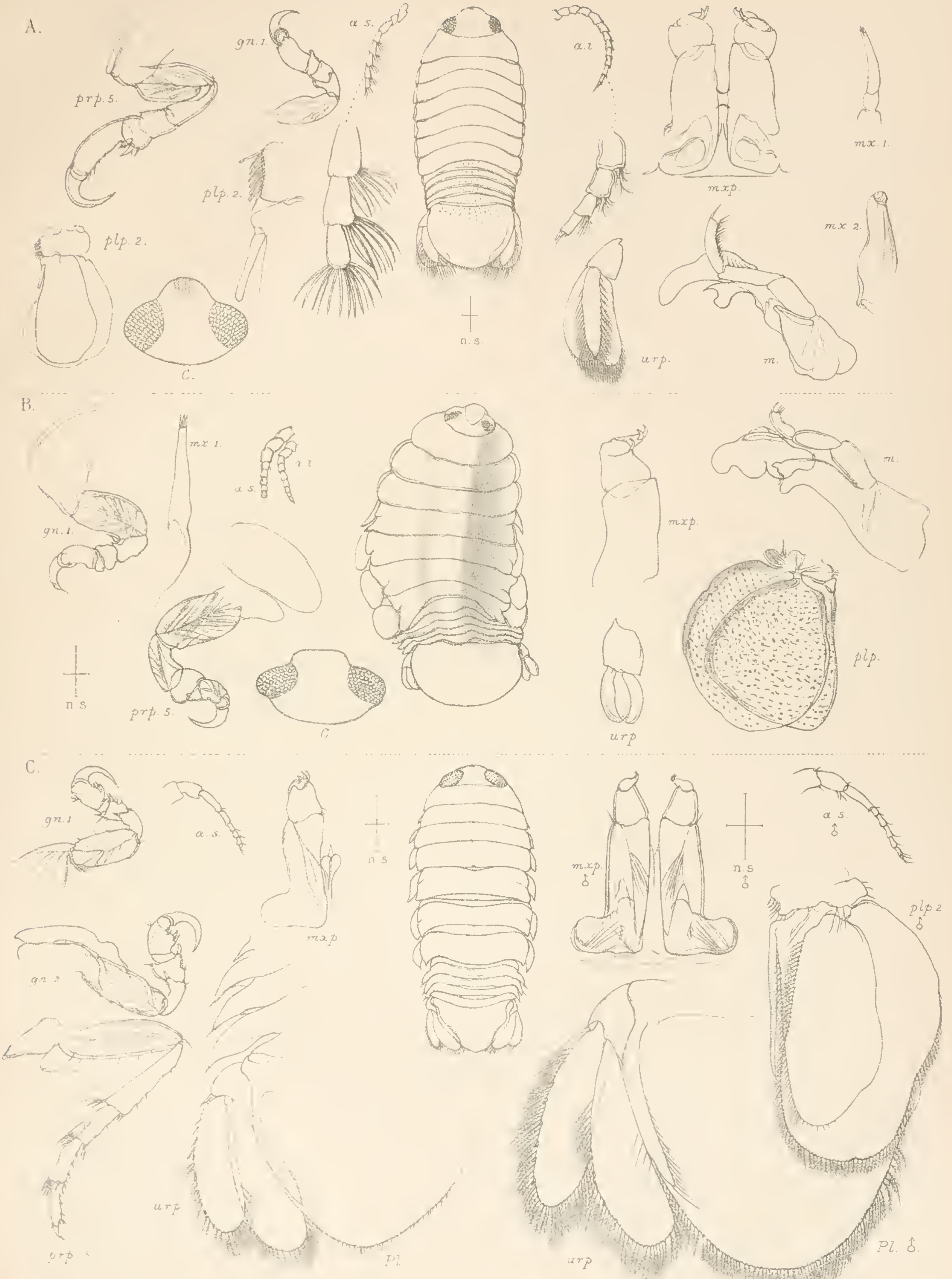
Del. T. R. R. Stebbing. J. T. Rennie Reid, Lith. Edin.

ÆGA OMMATOPHYLAX, n. sp.



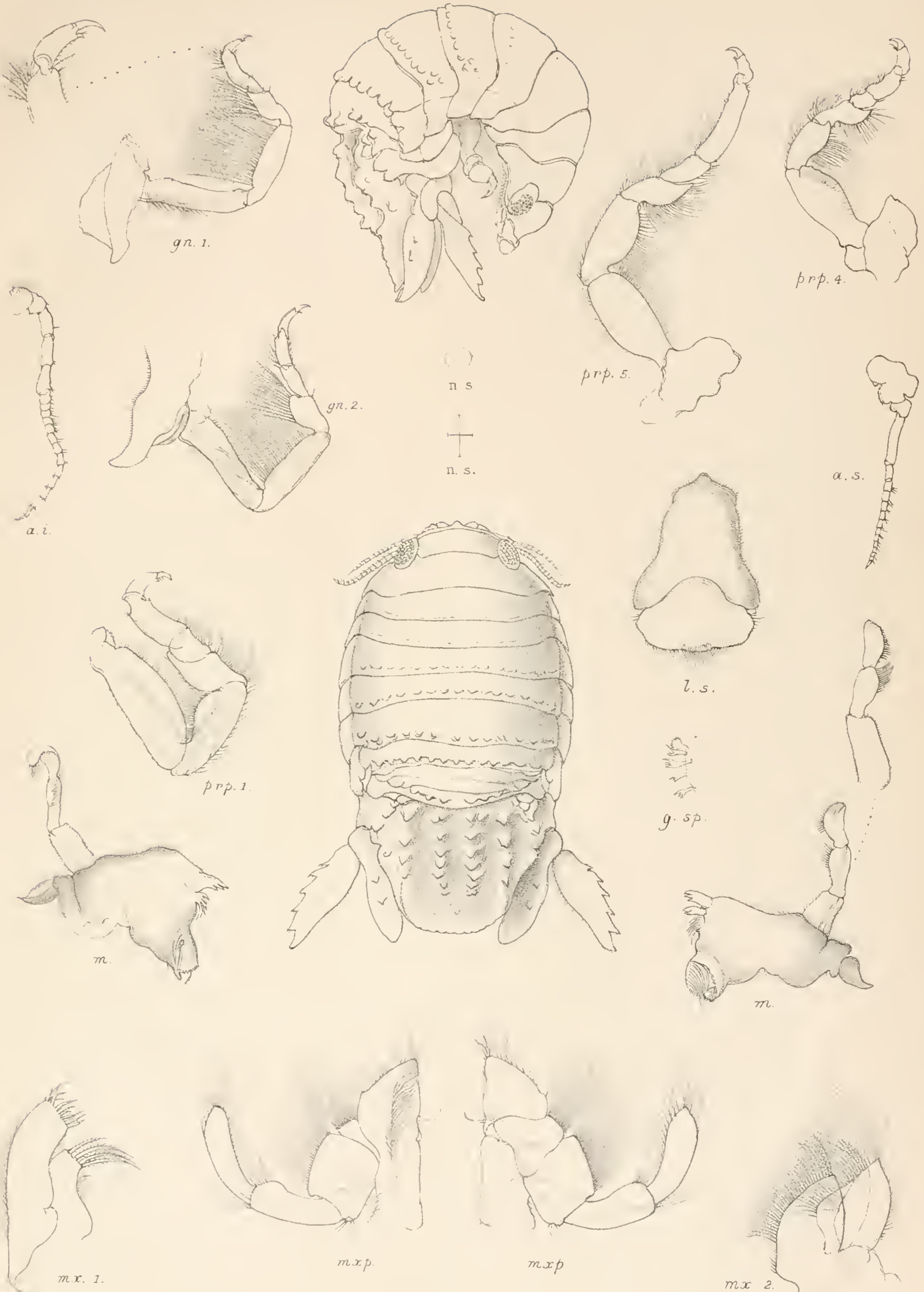
Del. T.R.R. Stebbing J.T. Rennie Reid Lith.

A. ÆGA OMMATOPHYLAX, n. sp. B. LANOCIRA ZEYLANICA, n. sp.



T R Reid, Lith.

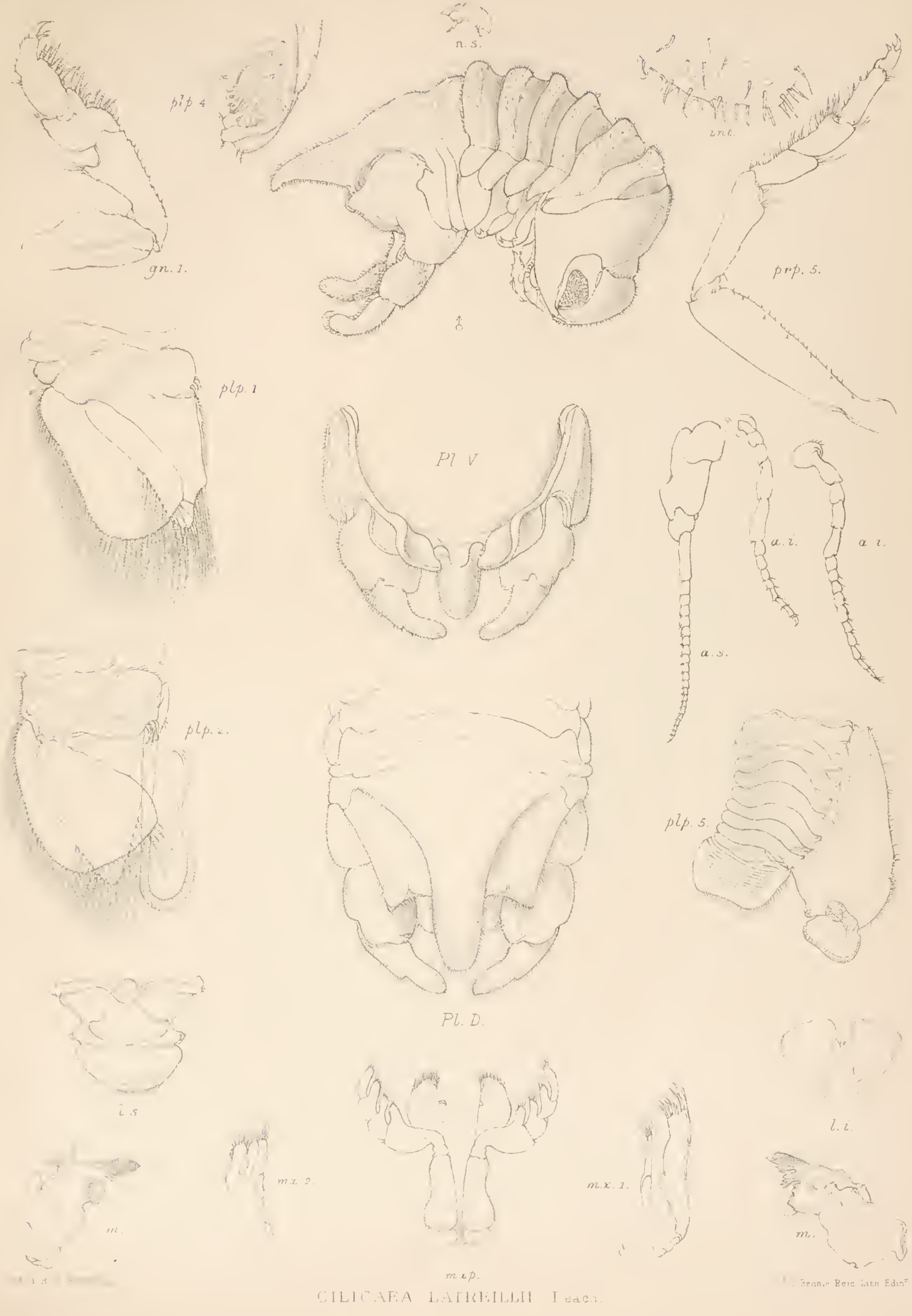
A. RHIOTHRA CALLIPIA, Schiödte & Meinert. B. IRONA NANOIDES, n. sp.
C. ROCINELA ORIENTALIS, Schiödte & Meinert.



Del T R R Stebbing

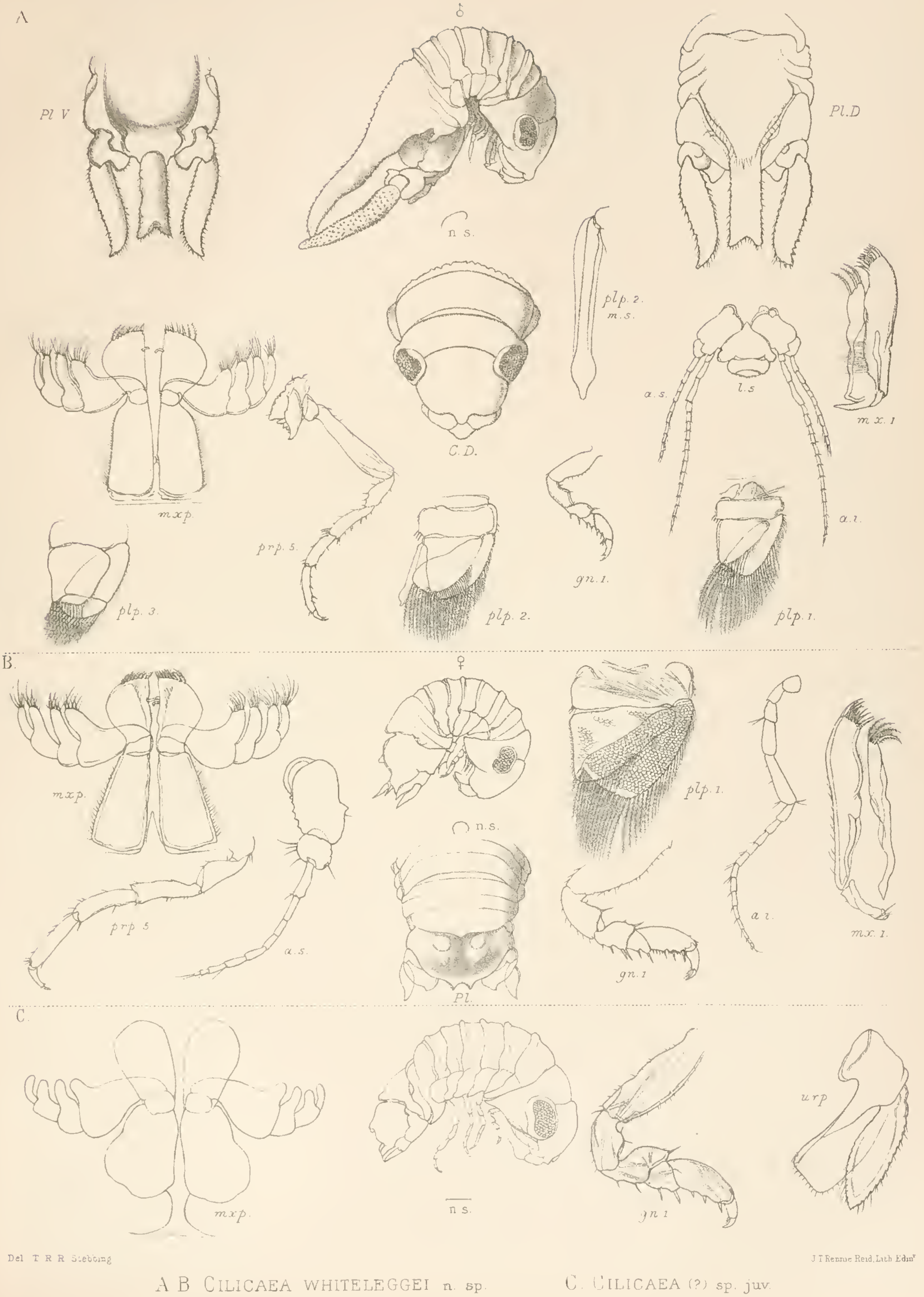
J T Rennie Reid Lith Edin

SPHAEROMA WALKERI, n sp



Rennie Reid Lith Edin.

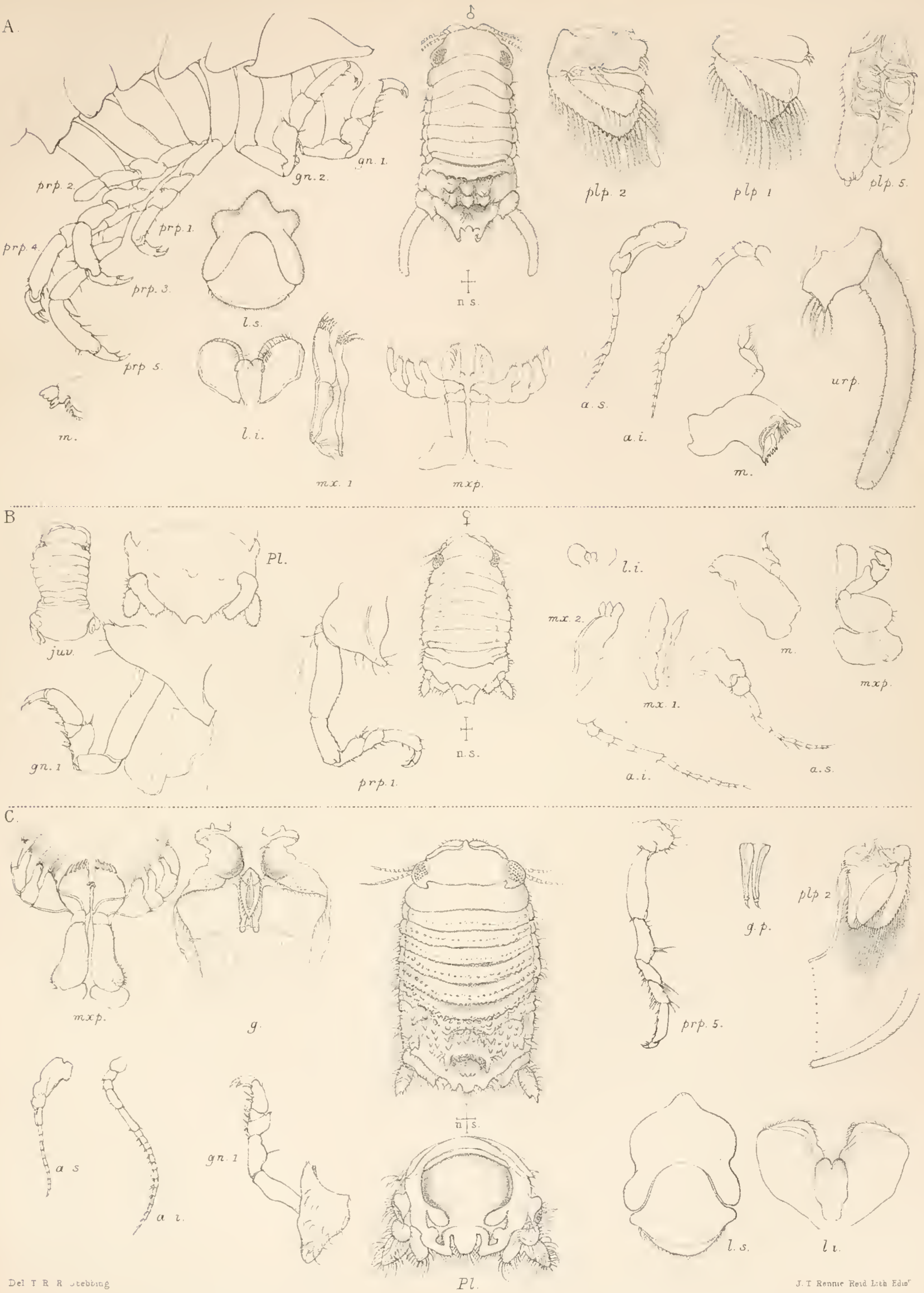
CILICAEA LATREILLII Leach.



Del T R R Stebbing

J T Rennie Reid, Lith Edin[r]

A B Cilicaea whiteleggei n. sp. C. Cilicaea (?) sp. juv.



Del T. R. R. Stebbing J. T. Rennie Reid Lith. Edin[r]

A.B. CILICAEA BEDDARDI, n. sp. C. CYMODOCE BICARINATA, Stebbing.

del. T. R. R. Stebbing J. T. Rennie Reid, Lith. Edinr.

A. AMESOPOUS RICHARDSONÆ, n. sp. B. ASTACILLA AMBLYURA, n. sp. C. JAEROPSIS CURVICORNIS, (Nicolet).

Del. T R R Stebbing J T Rennie Reid Lith Edin[r]

A, Stenetrium chiltoni, n. sp. B. Gnathia insolita, n sp

REPORT

ON THE

MACRURA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

JOSEPH PEARSON, B.Sc.,

DEMONSTRATOR AND ASSISTANT LECTURER IN ZOOLOGY, UNIVERSITY OF LIVERPOOL.

[WITH TWO PLATES.]

PROFESSOR HERDMAN'S collection of Macrurous Crustaceans from Ceylon consists of 53 species, of which 4 are new to science.

With the probable exception of 3 species the collection is entirely typical of a representative Indo-Pacific shallow-water fauna. *Bithynis savignyi* (SP. BATE), *Athanas nitescens*, LEACH, and *Urocaris longicaudata*, STIMPSON, appear hitherto to have had a known distribution limited to the Atlantic and the Mediterranean.

The following is a list of the species described in this Report:—

TRIBE: PENÆIDEA.

FAMILY: Penæidæ.

Penæus canaliculatus (OLIVIER).
,, *monodon*, FABRICIUS.
,, *indicus*, MILNE-EDW.
Parapenæus anchoralis (SP. BATE).
,, *incisipes* (SP. BATE).
,, *dalei*, RATHBUN.
,, *mogiensis*, RATHBUN.
,, *acclivis*, RATHBUN.
gallensis, n. sp.
Philonicus pectinatus, SP. BATE.
Sicyonia lancifer (OLIVIER).
,, *cristata* (DE HAAN).
,, *sculpta*, MILNE-EDW.

FAMILY: Sergestidæ.

Acetes indicus (MILNE-EDW.).
Leucifer typus (VAUGH. THOMPS.).

TRIBE: CARIDEA.

FAMILY: Atyidæ.

Caradina vitiensis, BORRADAILE.

FAMILY: Pontoniidæ.

Periclimenes vitiensis, BORRADAILE.
,, *danæ* (STIMPSON).
Conchodytes meleagrinæ, PETERS.
Anchistus inermis (MIERS).

FAMILY: Palæmonidæ.

Bithynis savignyi (SP. BATE).
Urocaris longicaudata, STIMPSON.

FAMILY: Latreutidæ.

Nauticaris futilirostris, SP. BATE.
,, *unirecedens*, SP. BATE.
,, *grandirostris*, n. sp.
Latreutes ceylonensis, n. sp.

FAMILY: Alpheidæ.

Alpheus idiocheles, COUTIÈRE.
,, *phrygianus*, COUTIÈRE.
,, *paraculcipes*, COUTIÈRE.
,, *paralcyone*, COUTIÈRE.
,, *miersi*, COUTIÈRE.
,, *pareucheirus*, COUTIÈRE.
,, *bis-incisus*, var. *malensis*, COUTIÈRE.
,, ,, ,, *stylirostris*, COUTIÈRE.
,, *audouini*, COUTIÈRE.
,, *macrodactylus*, ORTMANN.
,, *spongiarum*, COUTIÈRE.
,, *lævis*, RANDALL.
Synalpheus gravieri, COUTIÈRE.
Synalpheus laticeps, COUTIÈRE.
,, *biunguiculatus*, STIMPSON.
,, *comatulorum*, HASWELL.
,, *neomeris*, DE MAN.
,, *carinatus*, DE MAN.
Athanas nitescens, LEACH.
,, *orientalis*, n. sp.

FAMILY: Crangonidæ.

Ægeon cataphractus (OLIVIER).

FAMILY: Processidæ.

Processa canaliculata, LEACH.

TRIBE: SCYLLARIDEA.

FAMILY: Scyllaridæ.

Scyllarus tuberculatus (SP. BATE).
,, *sordidus* (STIMPSON).

TRIBE: THALASSINIDEA.

FAMILY: Callianassidæ.

Callianassa rotundicaudata, STEBBING.
,, *maldivensis*, BORRADAILE.
Upogebia intermedia (DE MAN).

In addition to the above species, two fresh-water forms—*Bithynis lar* and *Bithynis grandimanus*—were obtained from the River Gin Ganga. They are not included in this Report.

LIST OF STATIONS

at which Macrura were obtained, with the species collected in each:—

STATION I.—Five miles west and south-west of Negombo; 12 to 20 fathoms; bottom coarse yellow sand with a few dead shells.

Parapenæus mogiensis.

STATION III.—Two and a-half to four miles off Chilaw; 9 to 14 fathoms; bottom coarse sand and small corals.

Penæus canaliculatus, Parapenæus anchoralis, Parapenæus dalei, Parapenæus mogiensis, Parapenæus acclivis, Philonicus pectinatus, Sicyonia lancifer, Anchistus inermis, Periclimenes danæ, Alpheus miersi, Alpheus phrygianus, Alpheus audouini, Synalpheus gravieri, Synalpheus neomeris, Processa canaliculata, Callianassa maldivensis.

STATION VI.—Across Muttuvaratu Paar; depth 6 to 9 fathoms; bottom sand, with hard patches of "rock" at intervals.

Leucifer typus, Bithynis savignyi, Alpheus idiocheles, Athanas orientalis, Processa canaliculata, Upogebia intermedia.

STATION XVIII.—South-west part of Palk Bay, off Rameswaram Island and Adam's Bridge; 7 to 9 miles off shore; bottom fine soft bluish-grey mud containing casts of various Molluscan shells; depth 7 to 8 fathoms.

Penæus monodon, Parapenæus mogiensis, Leucifer typus.

STATION XX.—North part of Back Bay, Trincomalee; depth 11 to 13 fathoms; bottom hard.

Parapenæus anchoralis, Parapenæus dalei, Parapenæus acclivis, Sicyonia sculpta.

STATION XXXV.—Entrance to Galle Harbour; depth $4\frac{1}{2}$ to 7 fathoms; bottom coarse sand.

Nauticaris unirecedens, Nauticaris grandirostris, Ægeon cataphractus, Scyllarus tuberculatus.

STATION XXXVI.—Galle Harbour, off Gibbet Island; depth 2 to $4\frac{3}{4}$ fathoms; bottom fine sand and mud.

Parapenæus dalei, Leucifer typus, Acetes indicus, Caradina vitiensis, Nauticaris futilirostris.

STATIONS XXXIX. to XLII.—Deep water off Galle; depth up to 100-fathom line; bottom sand, shells, nullipores.

Parapenæus dalei, Parapenæus mogiensis, Parapenæus acclivis, Parapenæus gallensis, Synalpheus laticeps, Synalpheus biunguiculatus, Synalpheus carinatus, Alpheus lævis.

STATION XLIII.—Six miles west of Kaltura; depth 22 fathoms; bottom hard sand and nullipores.

Parapenæus anchoralis, Philonicus pectinatus.

STATIONS XLVII. to XLIX.—Cheval Paar; depth $6\frac{1}{2}$ to 13 fathoms; bottom sand, nullipores and dead shells.

Penæus indicus, Parapenæus anchoralis, Leucifer typus, Periclimenes vitiensis, Periclimenes danæ, Conchodytes meleagrinæ, Anchistus inermis, Alpheus phrygianus, Alpheus paraculeipes, Alpheus miersi, Alpheus spongiarum, Alpheus bis-incisus, var. *malensis, Synalpheus gravieri, Synalpheus comatulorum, Athanas nitescens, Athanas orientalis, Processa canaliculata, Callianassa rotundicaudata.*

STATION LIII.—Ten to twelve miles north of Cheval Paar, and 12 miles west of Vankali Church; depth $7\frac{1}{2}$ to 9 fathoms; bottom muddy sand with dead shells.

Latreutes ceylonensis.

STATION LIV.—South of Adam's Bridge; depth 4 to 40 fathoms; bottom varied, from sand to living coral.

Conchodytes meleagrinæ, Alpheus pareucheirus, Upogebia intermedia.

STATIONS LV. to LX.—Coral reefs and pearl banks, Gulf of Manaar; depths varying from 9 to 36 fathoms; bottom nullipores and dead coral.

Parapenæus mogiensis, Sicyonia cristata, Conchodytes meleagrinæ, Alpheus miersi, Alpheus bis-incisus, var. *stylirostris, Alpheus audouini, Synalpheus gravieri, Synalpheus comatulorum, Synalpheus laticeps, Synalpheus biunguiculatus, Athanas orientalis, Scyllarus sordidus.*

STATION LXI.—Northern end of Periya Paar; depth 12 to 14 fathoms; bottom sand, nullipores and coral.

Leucifer typus, Sicyonia cristata, Synalpheus gravieri, Athanas orientalis.

STATION LXIV.—From between South Modragam and Jagerboom paars along a line south-west towards Kodramallai Point; depth 4½ to 5½ fathoms; bottom coarse sand, with much fine green weed and small pearl oysters.

Periclimenes vitiensis, Processa canaliculata.

Aripu Reef; depth 5 fathoms.

Parapenæus acclivis, Parapenæus anchoralis, Philonicus pectinatus, Urocaris longicaudata, Scyllarus tuberculatus.

STATION LXVII.—Off south end of Mutwal Island; depth 10 to 14 fathoms; bottom dead coral and nullipore.

Synalpheus gravieri, Alpheus paralcyone, Alpheus miersi, Alpheus macrodactylus.

STATION LXVIII.—From off Coppeluddi southwards to Navakaddua Paar; depth 8 to 18½ fathoms; bottom nullipores, coral and muddy orbitolites sand.

Synalpheus comatulorum.

STATION LXIX.—North end of Chilaw Paar; depth 8 to 11 fathoms; bottom yellow quartz sand with some coral fragments.

Synalpheus biunguiculatus, Synalpheus comatulorum, Nauticaris unirecedens.

MACRURA.

Tribe: PENÆIDEA.

Family: PENÆIDÆ.

Penæus, Fabricius, 1798.

Penæus canaliculatus (Olivier).

Palæmon canaliculatus, Olivier, 'Ency. Méthod.,' VIII., p. 660, 1811.
Penæus canaliculatus, Milne-Edwards, 'Hist. Nat. Crust.,' II., p. 414, 1837.
Penæus canaliculatus, var. **japonicus**, Sp. Bate, '"Challenger" Macrura,' p. 245, 1888.

Locality:—Pearl banks, Gulf of Manaar (Station III.), 1 specimen very much damaged.

General distribution:—Japan, Mauritius, Figi, Australia, Ceylon.

Penæus monodon, Fabricius.

Penæus monodon, Fabricius, 'Suppl. Ent. Syst.,' p. 408, 1798.

Penæus semisulcatus, de Haan, 'Fauna Japonica,' p. 191, 1849.

Penæus carinatus, Dana, 'U.S. Expl. Exp.,' p. 602, 1852.

Locality :—Palk Strait (Station XVIII.), several specimens.

Measurements of two males and two females :—

	Males.		Females.	
From end of telson to tip of rostrum . .	162 millims.,	131 millims.	195 millims.,	135 millims.
Length of carapace and rostrum . .	52 ,,	41 ,,	60 ,,	43 ,,

Both male and female specimens possess a well-marked median groove extending from behind the rostrum to the posterior end of the carapace. Spence Bate found this groove absent in the single male which he examined. There is no doubt that the position of the ventral rostral teeth relative to the upper rostral teeth is subject to variation.

General distribution :—India, Ceylon, Singapore, Japan, Pacific and South Africa.

Penæus indicus, Milne-Edw.—Plate I., fig. 1.

Penæus indicus, Milne-Edw., 'Hist. Nat. Crust.,' II., p. 415, 1837.

(?) **Penæus merguiensis**, de Man, 'Journ. Linn. Soc.' (Zool.), vol. 22, p. 287, 1888.

Locality :—Gulf of Manaar (Station XLIX.), 5 specimens. Lengths varying from 14 millims. to 40 millims. All immature.

The rostrum in these specimens differs from the type species and has a formula $\frac{1+(6 \text{ to } 7)}{6}$. The anterior half of the rostrum bears no teeth dorsally. The rostrum is very slender and extends in front of the antennular peduncle a distance equal to half the length of the peduncle. In spite of these differences from the type species, I have referred these specimens to the above species, because there seems to be little doubt that the rostrum is subject to a great deal of variation in this form. The "Challenger" specimens differed in the form of the rostrum from Milne-Edward's species, and de Man's species, *P. merguiensis*, appears to differ in no important respects from *P. indicus*.

An examination of the various forms grouped together under this species would be valuable and instructive, and would throw some light on the value of the rostrum in classification.

General distribution :—India, Philippines, Mergui (?), Ceylon.

Parapenæus, SMITH, 1885.

I have followed SMITH* in separating certain species from the genus *Penæus*. The characters of the genus *Parapenæus*, which distinguish it from the genus *Penæus*, are:—(1) Endopodite of 1st maxilla is short and unsegmented; (2) 3rd maxilliped without an epipodite, and (3) the absence of branchiæ from the last thoracic segment.

Parapenæus anchoralis (SP. BATE).

Penæus anchoralis, SP. BATE, '"Challenger" Macrura,' p. 258, 1888.

Localities:—Pearl banks, Gulf of Manaar (Station III.), 1 specimen (♀); Trincomalee (Station XX.), 1 specimen (♀); off Kaltura (Station XLIII.), 1 ♂; Galle (Station XXXVII.), 1 ♀; Aripu Reef (Station XLIV.), 1 ♂ and 2 ♀.

Male:—Total length 40 millims., carapace and rostrum 15 millims.

Female:—Total length 64 millims., carapace and rostrum 23 millims.

Rostral formula is $\frac{(8 \text{ to } 9)+1}{0}$.

The rostrum in the females appears to be slightly longer than in the males. The female rostrum reaches to the end of the second antennular segment. In the male it only reaches slightly past the first segment.

The dorsal groove of the telson appears to be deeper in the female than in the male.

General distribution:—Pacific, Japan, Ceylon.

Parapenæus incisipes (SP. BATE).

Penæus incisipes, SP. BATE, '"Challenger" Macrura,' p. 257, 1888.
Parapenæus incisipes, RATHBUN, 'Proc. U.S. Nat. Mus.,' vol. xxvi., p. 38, 1902.

Locality:—Gulf of Manaar, 1 specimen, ♂.

The rostrum is straight and not so deep as in the preceding species. It extends to the middle of the 3rd joint of the antennular peduncle. Rostral formula is $\frac{9+1}{0}$.

The flagella of the antennule are short and equal in length to the 2nd and 3rd joints of the peduncle.

Two obliquely longitudinal grooves cross each side of the carapace. The anterior groove becomes comparatively deep ventrally. The carapace tends to become much shallower dorso-ventrally at the anterior end.

The meropodite of the 5th pereiopod is notched at its proximal end. There is a tubercle present on the endopodite of the 2nd abdominal appendage. The 6th abdominal segment is $1\frac{1}{2}$ times as long as the 5th. The uropods are slightly notched at their outer proximal margins.

General distribution:—Philippines, Japan, Ceylon.

* SMITH, 'Proc. U.S. Nat. Mus.,' VIII., p. 170, 1885.

Parapenæus dalei, Rathbun.*

Parapenæus dalei, M. Rathbun, 'Proc. U.S. Nat. Mus.,' vol. xxvi., p. 40, 1902.

Localities:—Pearl banks, Gulf of Manaar (Station III.), 1 ♂; Galle (Station XXXVI.), 2 ♂; south of Galle (Station XXXIX.), 1 ♂; Trincomalee (Station XX.), 1 ♂.

These specimens appear to agree with Miss Rathbun's diagnosis of the species. The antennular flagella are thicker than in the other species of the *velutinus* group.

Length of largest specimen (♂):—

Total length from end of rostrum to tip of telson . .	40 millims.
From tip of rostrum to end of carapace	11 ,,
Side length of carapace	9 ,,

Rostral formula $\frac{6+1}{0}$.

General distribution:—Japan, Ceylon.

Parapenæus mogiensis, Rathbun—Plate I., fig. 2.

Parapenæus mogiensis, M. Rathbun, 'Proc. U.S. Nat. Mus.,' vol. xxvi., p. 39, 1902.

Localities:—Pearl banks, Gulf of Manaar (Station III.), 31 specimens; west of Negombo, hauls 1 to 4 (Station I.), 15 specimens; Palk Straits (Station XVIII.), 2 specimens; south of Galle (Station XXXIX.), 1 specimen; Coral reef, Gulf of Manaar (Station LIV.), 7 specimens.

The petasma agrees with the type, but the thelycum in all the specimens shows a slight difference (see fig. 2). The appendages are more richly setose than is the case with the other species of this group. The 3rd maxillipeds do not extend as far as the tips of the antennal scales, but are situated behind them a distance equal to the length of the distal joint of the 3rd maxilliped. The antennal scale is slightly longer than the antennular peduncle.

Dimensions of males (3 specimens):—

Total length	56 millims.,	48 millims.,	61 millims.
Length of rostrum and carapace . .	18 ,,	15 ,,	19 ,,
Lateral length of carapace . . .	15 ,,	12 ,,	14 ,,

Dimensions of females (3 specimens):—

Total length	75 millims.,	67 millims.,	61 millims.
Length of rostrum and carapace . .	24 ,,	23 ,,	20 ,,
Lateral length of carapace . . .	19 ,,	18 ,,	16 ,,

Rostral formula $\frac{8+1}{0}$.

General distribution:—Japan, Ceylon.

* This and the three following species belong to the *Parapenæus velutinus* group. This collection of Ceylon Crustaceans has given me an opportunity of examining a large number of specimens belonging to

Parapenæus acclivis, Rathbun.

Parapenæus acclivis, Rathbun, 'Proc. U.S. Nat. Mus.,' vol. xxvi., p. 41, 1902.

Localities:—Pearl banks, Gulf of Manaar (Station III.), 1 specimen; Trincomalee (Station XX.), 1 specimen; south of Galle (Station XXXIX.), 1 specimen; Aripu Reef (Station LXIV.), 1 specimen.

The 3rd maxillipeds do not extend as far as the ends of the antennal scales, but they are longer than those of *Parapenæus mogiensis.* The antennal scale is slightly shorter than the antennular peduncle.

Dimensions of two females:—

Total length	88 millims.,	80 millims.
Length of rostrum and carapace	29 ,,	26 ,,
Lateral length of carapace	25 ,,	21 ,,

Rostral formula $\frac{(7 \text{ to } 8)+1}{0}$.

General distribution:—Japan, Ceylon.

Parapenæus gallensis, n. sp.—Plate I., fig. 3.

Locality:—South of Galle (Station XXXIX.), many specimens.

This species is of the *velutinus* type, and possesses certain characters which distinguish it from Dana's species and also from the species formed by Miss Rathbun.

In the form of the rostrum this species resembles somewhat closely *P. dalei.* The length of the rostrum, however, is slightly shorter than in the latter species. In typical specimens the rostrum reaches to the end of the 1st segment of the antennular peduncle. In *P. dalei* the rostrum reaches to the middle of the 2nd segment. The rostrum in *P. gallensis* is generally less toothed than in *P. dalei*, having a formula of $\frac{(5 \text{ to } 6)+1}{0}$. The anterior tooth is much smaller than the others, and in some cases is hardly perceptible. But in the form of the petasma and thelycum it differs distinctly from *P. dalei*, and approaches nearer to *P. akayebi*, showing, however, distinct differences from the latter species. The rostrum is much shorter than in *P. akayebi* and has fewer teeth. The left branch of the petasma is much more delicate and slightly longer than the right branch, and ends in a few small denticles, which, however, are only observed when the petasma is examined under a microscope. The antennal scale reaches as far forward as the extremity of the antennular peduncle. The 3rd maxillipeds are slightly longer than those of the three previous species, reaching almost to the end of the antennal scale. There is a pair of well-developed

to the *velutinus* group, and I think Miss Rathbun is justified in separating from the old species certain forms possessing various definite and distinctive characters. But it is doubtful whether these characters are of sufficient importance to warrant the formation of new *species*, and I am not sure whether their separation from *Parapenæus velutinus* merely as new varieties would not have been preferable.

spines present between the bases of the feet of the second pair. These only appear to be present in the female. The last four abdominal segments have a dorsal carina which ends in a well-developed tooth at the posterior end of the 6th segment. The sixth abdominal segment is about $1\frac{1}{2}$ times as long as the fifth and slightly shorter than the telson. The telson is slightly shorter than the uropods and has the usual number of spines, which is characteristic of the *velutinus* group. The anterior pair of spines are much smaller than the posterior three pairs, and in some specimens are only observed with difficulty.

The general surface of the body is smooth. The dimensions are :—

	millims.	millims.	millims.	millims.	millims.	millims.
Total length along mid-dorsal line from tip of rostrum to end of telson . .	49	43	50	48	59	40
Length of carapace and rostrum along mid-dorsal line	15	13	15	14	17	10·5
Side length of carapace to tip of antennular tooth	13	10	12	12	15	9
Length of sixth segment of abdomen, mid-dorsal line	7	6	7	6	7·5	5
Sex	♀	♀	♀	♀	♀	♂

It would appear that this species is in an intermediate position between *Parapenæus akayebi* and *P. dalei*.

The characters of the rostrum and of the petasma and thelycum appear to be the most reliable characters on which to base the identification of the various species of this group. Of these characters the former is not altogether trustworthy, as it is subject to some variation, and it is not impossible to obtain a series based upon the length of the rostrum and the number of rostral teeth which will connect all the species of this group. Still, in a broad manner, Miss RATHBUN's method of separation holds good.

The form of the genital opercula appears to be much more constant, and each of the species is quite distinct in this respect.

The comparative length of the sixth abdominal segment does not seem to be constant enough to be of value as a basis of identification.

So that, as I have already suggested, it is, perhaps, placing too high a value upon the distinguishing characters of the various forms of the *velutinus* group to give these forms the rank of species. For the present, however, I follow Miss RATHBUN.

Philonicus, SPENCE BATE, 1888.

Philonicus pectinatus, SP. BATE.

Philonicus pectinatus, SP. BATE, '"Challenger," Macrura,' p. 279, 1888.

Localities :—Deep water off Galle (Station XL.), 1 specimen ♀, 35 millims. ; off

Kaltura (Station XLIII.), 2 ♀, 35 millims. and 48 millims.; Pearl banks, Gulf of Manaar (Station III.), 1 ♀, 48 millims.; Aripu Reef (Station LXIV.), 1 ♂, 35 millims.

All the specimens are much damaged, the exoskeleton apparently being poorly calcified. In all the female specimens the thoracic legs are incomplete.

In the male the petasma is comb-like as described by SP. BATE. The antennular flagella, which were absent in the "Challenger" specimen, are typical of the genus. There are two long flagella on each antennular peduncle, the upper one being thin and the lower being very broad. The antennal scale is well developed and is longer than the antennular peduncle and twice as long as the antennal peduncle. The antennal flagellum is long and is slightly thicker than the upper antennular flagellum. The form of the rostrum and carapace agrees with SPENCE BATE'S description. In the "Challenger" specimen the 3rd maxillipeds and the thoracic legs were absent.

In the Ceylon specimens the 3rd maxillipeds are very long, reaching well in front of the antennal scale. The distal end of the propodite is about on a level with the end of the antennal scale. All the joints are richly covered with setæ, some of which are so robust as to have the appearance of long slender spines. Of the thoracic legs the first is the shortest and only reaches to the end of the carpos of the 3rd maxilliped. The second leg reaches to the end of the propodite of the 3rd maxilliped. The third pair is missing. The fourth is very long and slender, reaching almost as far forward as the end of the 3rd maxilliped. The last pair of thoracic legs are short, being only slightly longer than the 1st pair and more slender.

Comparative lengths of appendages in male specimen:—

3rd maxilliped	12 millims.
1st thoracic leg	9 ,,
2nd ,, ,, ...	11·5 ,,
3rd (wanting)	—
4th thoracic leg	14 millims.
5th ,, ,, ...	10 ,,

General distribution:—Papua, Ceylon.

Sicyonia, MILNE-EDW., 1830.

Sicyonia lancifer (OLIVIER).

Palæmon lancifer, OLIVIER, 'Encyclop.,' t. vi., p. 664.
Sicyonia lancifer, DE HAAN, 'Fauna Japonica,' p. 194, 1849.
Sicyonia lancifer, SP. BATE, '"Challenger" Macrura,' p. 297, 1888.

Locality:—Pearl banks, Gulf of Manaar (Station III.), 3 ♀ and 1 ♂, average length 40 millims.

There is very little to add to SPENCE BATE'S description and figures.

In the male the petasma is symmetrical, and there is a conspicuous triangular plate between the bases of the last three pairs of thoracic legs, having the apex produced

into a long pointed tooth anteriorly like the thelycum in the female. As in the female, there is a pair of spines present at the base of each of the first two pairs of walking legs. The 3rd maxillipeds are similar in both sexes, and are more massive than the thoracic walking legs and extend slightly further forward than the tip of the antennal scale. They are richly setose and have the joints somewhat flattened. The first three pairs of walking legs are chelate and the carpopodite is only slightly longer than the propodite. The fingers are slightly longer than the palm.

General distribution :—New Guinea, Japan, Indian Ocean.

Sicyonia cristata (DE HAAN) (?).

> **Hippolyte cristatus**, DE HAAN, 'Fauna Japonica,' pl. xlv., 1849.
> **Sicyonia cristata**, DE HAAN, 'Fauna Japonica,' p. 194, 1849.

Localities :—West of Periya Paar (Station LXI.), 1 ♂, 25 millims. ; off Dutch Modragam (Station LVII.), 1 ♂, 25 millims. ; Coral reef, Gulf of Manaar (Station LIV.), 1 ♀, 35 millims.

I refer these specimens to the above species, although a little doubtful as to their identity. I have not been able to see figures of DE HAAN'S species, but these specimens agree closely with the description. SP. BATE evidently considered this species to be identical with *Sicyonia lancifer*. The Ceylon specimens resemble the latter species closely, but they possess characters differing from *S. lancifer*. The carapace is more arched than in *S. lancifer*. The rostrum does not turn up at the end and only reaches to the end of the eyes. The abdomen differs only from that of *S. lancifer* in not having pleural spines on each segment. The three distal joints of the 3rd maxillipeds appear to be more flattened than in *S. lancifer*, and the hepatic spine on the carapace is not so well developed as in that species.

General distribution :—Japan, Ceylon.

Sicyonia sculpta, MILNE-EDW.

> **Sicyonia sculpta**, MILNE-EDW., 'Ann. des Sci. Nat.,' sér. 1, t. 19, p. 339, 1830.

Locality :—Trincomalee (Station XX.), 1 ♀, 17 millims.

General distribution :—Atlantic, Mediterranean, Ceylon.

FAMILY: SERGESTIDÆ.

Acetes, MILNE-EDW., 1830.

Acetes indicus, MILNE-EDW.

> **Acetes indicus**, MILNE-EDW., 'Ann. des Sci. Nat.,' t. 19, p. 350, 1830.

Locality :—Galle Harbour (Station XXXVI.), 1 specimen, 14 millims. long, in a damaged condition, but evidently belonging to this species.

This species is generally found either in fresh water or in the brackish water of estuaries.

Distribution :—Mouth of River Ganges, Ceylon.

Leucifer, MILNE-EDW., 1837 (= **Lucifer**, VAUGHAN THOMPSON, 1829).

Leucifer typus (VAUGHAN THOMPSON).

Lucifer typus, VAUGHAN THOMPSON, 'Zool. Researches,' p. 58, 1829.
Leucifer typus, MILNE-EDW., 'Hist. Nat. Crust.,' t. ii., p. 469, 1837.

Localities:—Muttuvaratu Paar (Station VI.); Palk Strait (Station XVIII.); Galle Harbour (Station XXXVI.); south of Cheval (Station XLVII.); Cheval Paar (Station XLIX.); Periya Paar (Station LXI.). A large number of specimens from the various localities. It is probable that most of these specimens were taken in the tow-net, although the labels do not definitely say so, except in one instance.

Altogether there are some hundreds of specimens, and I am satisfied that they all belong to this species. It is worthy of note that in the separate gatherings the specimens are almost entirely of one sex.

The differences from SPENCE BATE'S description are very slight. In the male the eyes do not quite reach to the end of the 1st segment of the antennular peduncle. BATE describes them as reaching nearly to the end of the 2nd segment.

The antennal scale is shorter than the 1st segment of the antennular peduncle and about equal in length to the eye. In the females the eyes are slightly shorter than in the male, and in the females the spines at the base of the abdominal appendages are not so well developed as in SP. BATE'S figures.

General distribution:—North and South Atlantic, Pacific, Australia, Ceylon.

TRIBE: CARIDEA.

FAMILY: ATYIDÆ.

Caradina, MILNE-EDW., 1837.

Caradina vitiensis, BORRADAILE—Plate I., fig. 4.

Caradina vitiensis, BORRADAILE, 'P.Z.S.,' 1898, p. 1003.

Locality:—Galle (Station XXXVI.), 5 specimens, average length 13 millims.

These specimens appear to agree closely with BORRADAILE'S description, but the rostrum is not quite so richly toothed, having a formula $\frac{18-20}{6}$. The ventral rostral teeth are smaller than the dorsal ones. The anterior border of the eyes appears to be slightly concave in all the specimens. The chelæ of the first two pairs of thoracic legs are typical of the genus. The distal joint of the last thoracic legs has a large number of closely packed spines on its posterior border. The sixth abdominal segment is almost twice as long as the fifth, and the telson is equal in length to the sixth segment. The telson bears five pairs of small spines on its dorsal side. Each corner of the posterior border bears a small spine, and there are four pairs of longer spines arranged along the posterior border.

The Ceylon specimens are marine. BORRADAILE's Figi specimens were obtained from fresh water.

General distribution :—Figi and Ceylon.

FAMILY: PONTONIIDÆ.

Conchodytes, PETERS, 1851.

Conchodytes meleagrinæ, PETERS.

Conchodytes meleagrinæ, PETERS, 'Ges. naturf. Freunde, Berlin,' 1851.

Pontonia meleagrinæ, BATE, '"Challenger" Macrura,' p. 707, 1888.

Localities :—Cheval Paar (Station XLVIII.), four ♂; Cheval Paar (Station LIV.), two ♂ and two ♀ within *Pinna*; West Cheval (Station LVIII.) two ♂ and two ♀ from shell of *Pinna*.

The mouth parts agree with SPENCE BATE's description of the thoracic legs, the second pair are very massive and are longer than the body. The ischium, meros and carpos are subequal in length, and the three together are shorter than the palm, which is long and massive and more than twice as long as the fingers. The 1st, 3rd, 4th and 5th pairs are small, decreasing slightly in length from before backwards. The distal joint of the last three pairs is triunguiculate.

Dimensions of male specimen :—

Total length from rostrum to end of telson	24 millims.
Length of carapace and rostrum	10 ,,
1st thoracic leg	12 ,,
2nd ,, ...	27 ,,
3rd ,, ...	11 ,,
4th ,, ...	10 ,,
5th ,, ...	10 ,,

General distribution :—East Africa, Torres Straits, New Guinea, Pacific, Ceylon.

Anchistus, BORRADAILE, 1898.

Anchistus inermis (MIERS).

Harpilus inermis, MIERS, 'Zool. Coll. of "Alert,"' 1884.

Anchistus inermis, BORRADAILE, 'Ann. Mag. Nat. Hist.' (7), ii., 1898.

Localities :—Pearl banks, Gulf of Manaar (Station III.), three ♂ and two ♀; Cheval Paar (Station XLVIII), three ♂ and three ♀.

There is nothing to add to the original description. In most of the specimens the sides of the carapace and abdomen are only very slightly calcified.

General distribution :—West Australia, Ceylon.

Periclimenes, Costa, 1844.

Periclimenes vitiensis, Borradaile.

Periclimenes vitientis, Borradaide, 'Ann. Mag. Nat. Hist.' (7) ii., p. 383, 1898.

Localities:—Cheval Paar (Station XLVIII.), 1 specimen; south-east of Modragam (Station LXIV.), 1 specimen "on weed bearing oyster spat," length 18 millims.

General distribution:—Pacific, Ceylon.

Family: PALÆMONIDÆ.

Bithynis, Philippi, 1860.

Bithynis savignyi (Sp. Bate).

Brachycarpus savignyi, Sp. Bate, '"Challenger" Macrura,' p. 798, 1888.
Bithynis savignyi, Rathbun, 'Bull. U.S. Fish Comm.,' vol. 2, p. 124, 1900.

Locality:—Muttuvaratu Paar (Station VI.), 1 specimen, 12 millims.

Rostrum reaching to the end of the antennular peduncle and having a formula $\frac{7}{3}$. The antennular peduncle has the 1st joint broad and much flattened and equal in length to the sum of the 2nd and 3rd joints, which are cylindrical. The flagella are slightly longer than the peduncle. The scale of the antenna is as long as the rostrum. Thoracic legs are mostly missing, but the specimen agrees closely with Bate's description.

Up to the present this species appears to have only been recorded from the Atlantic.

General distribution:—Bermudas, West Indies, Ceylon.

Urocaris, Stimpson, 1860.

Urocaris longicaudata, Stimpson—Plate I., fig. 5.

Urocaris longicaudata, Stimpson, 'Proc. Ac. Nat. Sci. Phil.,' XII., p. 39, 1860.
Urocaris longicaudata, Rathbun, 'Bull. U.S. Fish Com.,' vol. 2, p. 126, 1900.

Locality:—Aripu Paar (Station LXIV.), 1 specimen. Female bearing eggs.

Dimensions:—

Total length from tip of rostrum to end of telson . . .	32	millims.
Length of carapace and rostrum along mid-dorsal line . .	8	,,
,, ,, along mid-dorsal line	4·5	,,
,, 1st abdominal segment along mid-dorsal line .	2	,,
,, 2nd ,, ,, ,, ,, .	2	,,
,, 3rd ,, ,, ,, ,, .	5	,,
,, 4th ,, ,, ,, ,, .	3	,,
,, 5th ,, ,, ,, ,, .	3	,,
,, 6th ,, ,, ,, ,, .	4	,,
,, telson ,, ,, ,, ,, .	4	,,

The rostrum is straight and slightly arched, semi-transparent except on the ventral side, which is strengthened by a thick ridge. There are nine dorsal teeth, the posterior of which is a little remote from the others and is situated on the carapace. There are two minute teeth at the tip of the rostrum on the ventral side. The rostrum reaches almost to the end of the 2nd segment of the antennular peduncle. The antennular peduncle has the 1st joint broad and flattened and equal to the sum of the 2nd and 3rd. There are two flagella, the outer of which is thicker and shows signs of bifurcation at its distal extremity. The flagella are slightly longer than the peduncle. The antennal peduncle is half as long as the 1st joint of the antennular peduncle. The flagellum is about as long as the body. The antennal scale is slightly longer than the antennular peduncle. The eye stalks are long and the eyes project laterally. The carapace bears on its anterior margin a well-developed spine below the eye and also a smaller spine ventral to this. There is also a large hepatic spine. Running along the carapace are two slight grooves. The dorsal groove starts behind the antennal spine and extends half the length of the carapace. The ventral groove starts at the anterior ventral border and traverses the entire length of the carapace in a sinuous manner. The first two pairs of legs are chelate, the second pair being longer and stouter than the first. The last three pairs are long and slender and have the dactylos biunguiculate. The abdomen is more than three-fourths the length of the body and is suddenly bent at right angles at the 3rd segment, the dorsal part of which is much swollen. The dorsal side of the last three abdominal segments forms a straight line. The 6th segment is long, being about one and a half times as long as the 5th, and equal in length to the telson. The telson is slightly shorter than the uropods and ends in two spines.

General distribution :—Atlantic coasts of North America, Ceylon.

Family: LATREUTIDÆ.

Nauticaris, Sp. Bate, 1888.

Nauticaris grandirostris, n. sp.—Plate I., fig. 6.

Locality :—Galle (Station XXXV.), 2 males.

The carapace has a prominent antennal spine and a spine at the antero-lateral border. as well as a spine on the anterior border half-way between these two spines. The median dorsal surface of the carapace is occupied by well-marked teeth, which are continued on to the rostrum. There is a well-developed rostrum, two-thirds as long as the carapace. The rostrum is deep and is turned upwards at the tip. There are six teeth occupying the whole of the mid-dorsal line of the carapace and the posterior half of the rostrum. Of these teeth the posterior one is very small and not easily made out. The others are well developed, the anterior tooth being slightly smaller than the rest. Only the first two of these teeth are situated on the rostrum. The anterior half of the rostrum bears no dorsal teeth. The extremity is marked by three small teeth. On the ventral side there are six teeth, the posterior four being

exceptionally well marked and deep. The antennular peduncle is short, and is only half the length of the rostrum. Its proximal joint is the largest, being equal to the sum of the other two. There are two branches to the flagellum. The inner branch reaches slightly beyond the rostrum, and the outer branch, which is slightly shorter, is much thicker and plumose, and shows signs of bifurcation at the tip. The antennular scale is almost as long as the peduncle. The antennal peduncle is as long as that of the antennule. The flagella are broken in both specimens. The scale is stout and reaches to the end of the rostrum. The mouth parts are similar in all important respects to those of *Nauticaris marionis.*

The 3rd maxillipeds reach past the end of the rostrum and have the distal joint tipped by about five well-marked spines. The proportionate lengths of the joints are similar to those of *N. marionis.* There are only four joints, and the second bears a large spine at its distal end. The 3rd joint is richly setose on its anterior face. The legs are robust, excepting the 2nd pair. The 1st pair are chelate and reach a little past the end of the antennal peduncle. The 2nd pair are long and slender and have a multi-articulate wrist. They reach to the extremity of the rostrum, the 3rd, 4th, and 5th pairs are similar to one another in form, decreasing slightly in length from before backwards. The 5th leg reaches to the base of the antennal scale. The carpos of each of the last three pairs bears a blunt process at the anterior distal border. The dactylos ends in two larger spines, and bears several smaller spines on its posterior border. The abdomen is robust and bent at right angles at the 3rd segment. There are two spines on the ventral side of each of the first four abdominal segments, and on the ventral side of the 5th and 6th segments there is a long median spine pointing backwards. The 6th abdominal segment has a well-marked movable spine at each of its posterior lateral borders, and also bears two well-marked spinous processes on its posterior border overhanging the telson. The uropods are slightly longer than the telson. The 2nd abdominal segment has a small transverse groove in the mid-dorsal line.

The telson tapers somewhat posteriorly and has a slightly grooved dorsal surface carrying two pairs of spines. The posterior border bears two pairs of spines and numerous long hairs.

Dimensions (measured along mid-dorsal line):—

From tip of rostrum to end of telson		50	millims.
Rostrum and carapace		20	,,
Carapace		11	,,
1st abdominal segment		2	,,
2nd ,,	,,	4	,,
3rd ,,	,,	8	,,
4th ,,	,,	$5\frac{1}{2}$	,,
5th ,,	,,	2	,,
6th ,,	,,	$3\frac{1}{2}$	,,
Telson		$5\frac{1}{2}$	,,

Nauticaris unirecedens, Sp. Bate.

Nauticaris unirecedens, Sp. Bate, '"Challenger" Macrura,' p. 608, 1888.

Localities :—Galle (Station XXXV.), 5 specimens; Jokkenpiddi Paar, 1 specimen.

These specimens agree closely with Sp. Bate's description, but the rostral formula is slightly different. The Ceylon specimens are not so richly toothed as the "Challenger" specimens.

Rostral formula $\frac{5+1}{2}$.

Average length 35 millims. (3 males and 3 females).

General distribution :—Hong Kong, Ceylon.

Nauticaris futilirostris, Sp. Bate—Plate II., fig. 8.

Nauticaris futilirostris, Sp. Bate, '"Challenger" Macrura,' p. 606, 1888.

Locality :—Galle Harbour (Station XXXVI.), 4 specimens taken in the tow-net. Average length 11 millims.

These specimens agree with Spence Bate's description; the posterior rostral tooth is slightly more remote from the others than in Bate's figure.

General distribution :—Off Japan, Ceylon.

Latreutes, Stimpson, 1860.

Latreutes ceylonensis, n. sp.—Plate II., fig. 7.

Locality :—Cheval Paar (Station LIII.), 1 specimen, 8 millims. long.

The latero-anterior edge of the carapace is furnished with 4 spines at each side. There is a deep rostrum, almost equal in length to the carapace. The carapace and rostrum together equal half the length of the body. The rostrum dips slightly downwards and bears dorsally two prominent teeth above the eyes and a tooth of equal size slightly behind the pointed anterior extremity. In addition to these there are about a dozen smaller teeth on the dorsal side which are only detected under a microscope. The under side of the rostrum is smooth. Each antennular peduncle is short, the proximal joint being as long as the sum of the other two. Each antennule has two flagella which reach to the end of the rostrum, and are slightly longer than the peduncle. The inner flagellum is slightly thicker and shorter than the outer. The antennal peduncles are slightly longer than those of the antennules. The antennal scale is large and broad, and extends slightly beyond the rostrum. Each scale is furnished with half-a-dozen small spines along its outer border. The antennal flagella are missing.

The first two pairs of thoracic legs are chelate. The 2nd pair are longer than the 1st pair and have the wrist 3-jointed. The remaining three pairs of legs are more strongly made, the meros and carpos being very broad. The dactylos terminates in two very robust spines.

The 3rd, 4th, and 5th abdominal segments each has the posterior part of its dorsal surface raised into a blunt keel. The abdominal segments are all subequal. The telson is long and narrow, and is twice as long as the 6th abdominal segment. It ends posteriorly in a blunt median spine, and is furnished with a lateral spine half-way along each side. The uropods are as long as the telson.

Family: ALPHEIDÆ.

Synalpheus, Sp. Bate, 1888.

Synalpheus gravieri, Coutière.

Synalpheus gravieri, H. Coutière, 'Fauna of Maldives and Laccadives,' p. 870, 1905.

Localities:—Pearl banks, Gulf of Manaar (Station III.), 7 specimens; Cheval Paar (Station XLVIII.), 19 specimens; Coral reef, Gulf of Manaar (Station LIV.), 2 specimens; west of Periya Paar (Station LXI.), 2 specimens, "commensal with dendritic Alcyonarian;" off Mutwal Island (Station LXVII.), 2 specimens.

The rostral and orbital spines are equal in length, the latter sometimes being slightly divergent. The rostrum does not reach the end of the 1st joint of the antennular peduncle. The 1st joint of the antennular peduncle is equal to the sum of the other two, the 2nd joint is twice as long as the 3rd. The antennular scale is a little longer than the 1st joint of the peduncle. The antennal peduncle is one and one-third times as long as the antennular peduncle. The outer spine of the antennal scale is as long as the antennular peduncle.

The 3rd pair of legs has a small spine on the dorsal side of the dactylos. The meros has 4 spines on its ventral posterior border. The propodite has about 8 spines on its posterior border.

General distribution:—Maldives, Ceylon.

Synalpheus laticeps, Coutière.

Synalpheus laticeps, Coutière, 'Fauna of Mald. and Lacc.,' p. 874, 1905.

Localities:—Coral reef, Gulf of Manaar (Station LIV.), 1 specimen; deep water off Galle (Station XL.), 4 specimens.

Orbital spines equal in length to rostrum, but slightly broader. Rostrum shorter than 1st joint of antennular peduncle. First joint of antennal peduncle longest, the 2nd and 3rd joints subequal. Antennular scale a little longer than the 1st joint of the antennular peduncle. The antennal peduncle one and one-fifth times as long as the antennular peduncle. Antennal scale as long as antennal peduncle.

Third legs having the dactylos biunguiculate, posterior border of propodite armed with about a dozen spines.

This species approaches closely to *S. biunguiculatus*.

General distribution:—Maldives, Ceylon.

Synalpheus biunguiculatus, Stimpson.

Synalpheus biunguiculatus, Stimpson, 'Proc. Acad. Phil.,' p. 31, 1860.

Localities :—Deep water off Galle (Station XL.), 2 specimens; Coral reef, Gulf of Manaar (Station LIV.), 14 specimens; Chilaw Paar (Station LXIX.), 1 specimen.

This species differs principally from the preceding species in (1) the rostrum and orbital spines being shorter in comparison with the 1st joint of the antennular peduncle; (2) the antennal scale is shorter, and only reaches to the end of the antennular peduncle; (3) the posterior border of the telson has a deeper curve.

General distribution :—Maldives, Philippines, Pacific, Ceylon.

Synalpheus carinatus, de Man—Plate II., fig. 9.

Synalpheus carinatus, de Man, 'Arch. f. Naturg.,' I., 1887.
Synalpheus carinatus, Coutière, 'Ann. des Sci. Nat.,' (8), t. ix., 1899.

Locality :—Deep water off Galle (Station XLI.), 2 specimens.

The rostral spine is more than twice the length of the orbital spines and reaches nearly to the end of the 1st segment of the antennular peduncle. The rostrum and the orbital spines point slightly upwards. The 1st segment of the antennular peduncle is slightly longer than the 2nd and twice as long as the 3rd. The antennular spine reaches to the end of the 1st peduncular segment. The antennal peduncle is slightly longer than the antennular peduncle. The antennal scale reaches to the end of the antennular peduncle. The large chela is on the left side. The carpopodite has a strong ventral spine. The dorsal side of the palm ends in a fairly prominent spine, immediately in front of the digits. This spine seems more strongly developed than in the type species.

In the 3rd pair of legs there is a spine on the ischiopodite, the meros is almost as long as the carpos and propodite combined, and bears 8 well-developed spines on the posterior border. The carpos bears a single spine at the distal end of its posterior border. The propodite has 8 spines on the posterior border. The dactylos is bifid.

In the male each of the abdominal pleura is produced posteriorly into a spine. In the female the pleura are rounded. The telson is as long as the uropods and tapers slightly. It carries two pairs of spines on the dorsal side and there are 3 spines at each of the posterior corners.

General distribution :—Indian Ocean.

Synalpheus comatulorum, Haswell.

Synalpheus comatulorum, Haswell, 'Cat. Austr. Crust.,' p. 187, 1882.
Synalpheus falcatus, Sp. Bate, '"Challenger" Macrura,' p. 574, 1888.

Localities :—Navakaddua Paar (Station LXVIII.), 4 specimens; Gulf of Manaar (Station LIV.), 3 specimens; Chilaw Paar (Station LXIX.), 1 specimen "on *Antedon*"; south end of Cheval Paar (Station XLVIII.), 1 specimen.

Rostrum twice as long as the orbital spines, and reaching to end of the 2nd

segment of antennular peduncle. Antennular scale reaching past the middle of the 2nd peduncular joint. The antennal peduncle is longer than the antennular peduncle. The antennal scale is as long as the antennular peduncle.

General distribution :—Australia, Maldives, Ceylon, Pacific.

Synalpheus neomeris, DE MAN.

Synalpheus neomeris, DE MAN, 'Zool. Jahr.,' 9. Bd., p. 734, 1897.

Locality :—Gulf of Manaar (Station III.), 1 specimen.

I have referred the single specimen to the above species. It appears to differ but slightly from *Synalpheus gravieri*.

General distribution :—Red Sea, Bay of Bengal, Madagascar, Australia, Japan, Maldives, Pacific, Ceylon.

Alpheus, FABRICIUS, 1778.

Alpheus idiocheles, COUTIÈRE.

Alpheus idiocheles, H. COUTIÈRE, 'Fauna of Mald. and Lacc.,' p. 883, 1905.

Locality :—Muttuvaratu Paar (Station VI.), 3 specimens.

Carapace deep. Rostrum short, and separated from the orbits by deep grooves. The orbits are well formed and unarmed. In the antennule the 1st and 3rd segments of the peduncle are subequal, each being half as long as the 2nd segment. The antennular scale reaches to the middle of the 1st peduncular segment. The antenna is short, only reaching three-fourths of the way along the 2nd joint of the antennular peduncle. The antennal scale is nearly as long as the antennal peduncle. The large chela is peculiar, having the dactylos portion of the digit hammer-shaped, and the propodite part short as in *Alpheus malleodigitatus*. The 3rd and 4th legs are robust and have the propodite armed with 5 spines, and end in a simple dactylopodite.

General distribution :—Maldives, Ceylon.

Alpheus phrygianus, COUTIÈRE.

Alpheus phrygianus, COUTIÈRE, 'Fauna of Mald. and Lacc.,' p. 886, 1905.

Localities :—Gulf of Manaar (Station III.), 2 specimens; Cheval Paar (Station XLVIII.), 2 specimens.

Somewhat similar to *A. idiocheles*. The eyes are not so prominent. The antennæ are comparatively longer, reaching to the end of the 2nd segment of the antennular peduncle. The antennal scale reaches to the middle of the 2nd segment of the antennular peduncle. The digits of the large chela are similar in shape to the preceding species, but the palm is broader.

General distribution :—Maldives, Ceylon.

Alpheus paraculeipes, COUTIÈRE.

Alpheus paraculeipes, COUTIÈRE, 'Fauna of Mald. and Lacc.,' p. 894, 1905.

Locality :—Cheval Paar (Station XLVIII.), 1 specimen.

Rostrum poorly developed. Orbits unarmed. 1st and 3rd segment of the antennular peduncle equal. 2nd segment twice as long as each of the others. Antennular scale not reaching to the end of the 1st segment. Antennal peduncle one and one-fourth times as long as the antennular peduncle. Spine of antennal scale as long as antennular peduncle.

The 3rd legs have the ischiopodite unarmed. The posterior border of the meropodite is fringed with about 20 very delicate spines and ends distally in a strong spine. The carpopodite has on its posterior external border 1 spine and about 5 hairs, and on its internal border about 15 long, fine spines. The propodite has 7 pairs of spines on its posterior border and is fringed with hairs anteriorly. The dactylos is slightly biunguiculate.

General distribution :—Maldives, Ceylon.

Alpheus spongiarum, Coutière.

Alpheus spongiarum, Coutière, 'Fauna of Mald. and Lacc.,' p. 895, 1905.

Locality :—Cheval Paar (Station XLVIII.), 1 specimen.

This species is very closely allied to *A. paraculeipes*, but differs in the form of the 3rd pair of legs. The meropodite is not so stout as in the latter species. Along the posterior border of the meropodite there are 7 very long hairs with about 15 short hairs between. The carpopodite has no spine on the posterior border and the dactylos is not bifid.

General distribution :—Maldives and Ceylon.

Alpheus paralcyone, Coutière.

Alpheus paralcyone, Coutière, 'Fauna of Mald. and Lacc.,' p. 895, 1905.

Locality :—Off Mutwal Island (Station LXVII.), 2 specimens.

Rostrum is well defined and slightly carinated behind. The 1st and 3rd segments of the antennular peduncle are subequal, and the 2nd segment is one and a half times as long as each of the others. Antennular scale very small, antennal peduncle one and one-third times as long as the antennular peduncle. The spine of the antennal scale reaches past the end of the antennular peduncle. The palm of the large chela is massive, narrowing distally, and the digits are very short.

In the 3rd pair of legs the ischiopodite is armed with a single spine, the meropodite is large and ends distally at the posterior border in a large spine. The carpopodite has about 4 spines on its posterior border, and the propodite has 8 pairs of spines. The dactylos is bifid.

General distribution :—Maldives, Ceylon.

Alpheus miersi, Coutière.

Alpheus miersi, Coutière, 'Fauna of Mald. and Lacc.,' p. 903, 1905.
Alpheus rapax, var. **miersi**, Coutière, 'Bull. Soc. Entom. de France,' No. 7, p. 166, 1898.

Localities :—Pearl banks, Gulf of Manaar (Station III.), 3 specimens; Cheval Paar

(Station XLVIII.), 3 specimens; Coral reef, Manaar (Station LIV.), 2 specimens; off Mutwal Island (Station LXVII.), 1 specimen.

Rostrum well developed, reaching to the end of the 1st segment of the antennular peduncle. The 2nd segment of the antennular peduncle is slightly longer than the 1st or 3rd, which are subequal. The antennal peduncle and scale are equal in length and slightly longer than the antennular peduncle. In the Ceylon specimens the large chela is massive and the palm is broad. The meropodite is spiny on its inferior border.

The 3rd pair of legs has the ischiopodite with a single spine. The meros is smooth except for a small spine at the posterior distal border. The carpos is smooth. The propodite bears five pairs of spines. The dactylopodite is half the length of the propodite and slightly curved.

General distribution :—Pacific, Japan, Maldives, Ceylon.

Alpheus pareucheirus, COUTIÈRE.

Alpheus pareucheirus, COUTIÈRE, 'Fauna of Mald. and Lacc.,' p. 906, 1905.

Locality :—Haul 6, south of Adam's Bridge (Station LIV.), 1 specimen.

The antennules and antennæ do not differ greatly from those of the preceding species. Their peduncles are not so stout. The rostrum is only two-thirds as long as the 1st segment of the antennular peduncle. The large chela differs in having the palm grooved on both sides. The meropodite is smooth. In the 3rd legs the ischiopodite does not bear a spine. The meropodite is smooth and not so robust as in the previous species. The carpos is smooth and the propodite bears 8 long spines on the posterior border. The dactylopodite is long and slightly curved.

General distribution :—Maldives and Ceylon.

Alpheus bis-incisus, var. **malensis**, COUTIÈRE.

Alpheus bis-incisus, var. **malensis**, COUTIÈRE, 'Fauna of Mald. and Lacc.,' p. 910, 1905.

Locality :—Cheval Paar (Station LXIX.), 1 specimen.

The rostrum is triangular, and separated from the orbits by two well-marked grooves. It reaches to the middle of the 1st segment of the antennular peduncle. The 1st and 2nd segments of the antennular peduncle are subequal and slightly longer than the 3rd. The antennular scale almost as long as the 1st peduncular segment. The peduncle and scale of the antennal are equal in length and slightly longer than the antennular peduncle.

I have placed this specimen in COUTIÈRE'S variety merely on the characters of the rostrum and antennæ. The large chela and most of the legs are missing.

General distribution :—Maldives and Ceylon.

Alpheus bis-incisus, var. **stylisostris**, COUTIÈRE.

Alpheus bis-incisus, var. **stylisostris**, COUTIÈRE, 'Fauna of Mald. and Lacc.,' p. 911, 1905.

Locality :—Coral reef, Gulf of Manaar (Station LIV.), 1 specimen.

This specimen appears to differ mainly from the variety *malensis* in the form of the rostrum, which is much narrower in proportion to its length.

General distribution :—Maldives and Ceylon.

Alpheus audouini, Coutière.

Alpheus edwardsi, Audouin (see Coutiere, 'Fauna of Mald. and Lacc.,' p. 911).
Alpheus audouini, Coutière, 'Fauna of Mald. and Lacc.,' p. 911, 1905.

Localities :—Off Mutwal Island (Station LXVII.), 2 specimens; Pearl banks, Gult of Manaar (Station III.), 6 specimens; Coral reef, Manaar (Station LIV.), 3 specimens.

This species, which Coutière has separated from *Alpheus edwardsi*, resembles the latter species in the form of the rostrum and in the appearance of the antennæ. The large chela has the dorsal and ventral projections of the palm rounded, thus differing from those of *A. edwardsi*, which are spiny.

General distribution :—Red Sea, Indian Ocean, Malay Archipelago, New Zealand, Sandwich Islands.

Alpheus macrodactylus, Ortmann.

Alpheus macrodactylus, Ortmann, 'Zool. Jahrb.,' V., p. 473, 1890.

Locality :—Off Mutwal Island (Station LXVII.), 1 specimen. Related to *A. edwardsi* and *A. euphrosyne*.

The rostrum is well pronounced and more than half as long as the 1st segment of the antennular peduncle. Of the joints of the antennular peduncle the 2nd is the longest, being twice as long as the 3rd and nearly twice as long as the 1st. The antennular scale is broad and reaches nearly to the end of the 1st segment of the peduncle. The antennal peduncle and scale are equal in length and extend as far forward as the end of the antennular peduncle. The large chela differs from that of *A. edwardsi* in the absence of a dorsal spine and in the comparatively greater length of the digits.

General distribution :—Australia, Ceylon.

Alpheus lævis, Randall.

Alpheus lævis, Randall, 'Journ. Acad. Nat. Sci. Phil.,' vol. viii., p. 141.

Localities :—Galle (Station XXXV.), 4 specimens; Coral reef near Galle (Station XL.), 5 specimens.

Well-developed rostrum reaching to the end of the 1st segment of the antennular peduncle. Orbits armed with two small spines. Segments of the antennular peduncle subequal. Antennular scale slightly longer than the 1st peduncular segment. Antennal peduncle and scale equal to one another and slightly longer than the antennular peduncle. The large chela has a massive palm, laterally compressed, with no dorsal or ventral notches. The carapace is deep.

General distribution :—Indian Ocean, Pacific, Australia.

Athanas, Leach, 1813.

Athanas nitescens, Leach.

Athanas nitescens, Leach, 'Edin. Encycl.,' vol. vii., p. 432, 1813.

Athanas veloculus, Sp. Bate, '"Challenger" Macrura,' p. 529, 1888.

Locality :—Cheval Paar (Station XLVII.), 1 specimen.

This specimen clearly belongs to the well-known species in which must be included—according to Coutière—Bate's species *Athanas veloculus*.

This record is of interest, inasmuch as the distribution of this species up to the present has been limited, so far as I can ascertain, to the Atlantic and Mediterranean.

General distribution :—Atlantic coasts of America, Cape Verd Islands, north-west Europe, Mediterranean, Ceylon.

Athanas orientalis, n. sp.—Plate II., fig. 10.

Localities :—Cheval Paar (Station XLVIII.), 2 specimens; Muttuvaratu Paar (Station VI.), 1 specimen; Coral reef, Gulf of Manaar (Station LIV.), 2 specimens; west of Periya Paar (Station LXI.), 2 specimens.

This species is in many respects very closely allied to *Athanas dimorphus*, Ortmann, and *A. minikoensis*, Coutière, but there are differences in the form of the extra- and infra-orbital spines, as well as in the form of the 1st pair of legs which lead me to place it in a new species.

The rostrum extends as far as the end of the 2nd joint of the antennular peduncle. The infra-corneal spine reaches slightly beyond the eye, and the extra-corneal spine just reaches to the anterior end of the eye, so that it is difficult to make out in side view. There is no supra-corneal spine.

The antennule has the 3 joints of its peduncle subequal, and its scale reaches as far forward as the end of the 2nd peduncular joint and the tip of the rostrum. The antennal peduncle reaches to the end of the 2nd joint of the antennular peduncle, and its scale, which is very broad, reaches slightly beyond the end of the antennular peduncle. In the small leg of the female the carpopodite and the propodite are about equal in length, but the latter is more robust. The meropodite is one and a half times as long as the carpopodite. The ischiopodite has a long delicate spine at the distal end of its dorsal border, and there are five smaller spines along the same border. This is the only specimen bearing the 1st pair of legs, so that it is not possible to compare these appendages in the male.

This species differs from the two allied species in the length of the rostrum and also in the relative lengths of the extra- and infra-orbital spines, as well as in the length and robustness of the joints of the small leg. The other two species are devoid of spines on the ischiopodite of that limb.

Family: CRANGONIDÆ.

Ægeon, Guérin-Méneville, 1835
(= Egeon, Risso, 1816).

Ægeon cataphractus (Olivier).

Cancer cataphractus, Olivier, 'Zool. Adriatica,' p. 30, 1792.
Egeon loricatus, Risso, 'Crust. de Nice,' p. 100, 1816.
Crangon cataphractus, Milne-Edw., 'Hist. Nat. Crust.,' vol. 2, p. 343, 1837.
Ægeon cataphractus, Ortmann, 'Zool. Jahrb.,' vol. 5, p. 535, 1890.

Locality :—Galle (Station XXXV.), 1 specimen.

This single specimen agrees closely with the type species, and also with Henderson's species, *Ægeon orientalis*,* in most respects. The latter species differs from the above species only slightly with regard to the teeth present on the carapace, and in the absence of the small hepatic groove on the sides of the carapace. Since the Indian species was formed from the characters of a single specimen, it is by no means improbable that this specimen merely represents an extreme variation of the parent species. In all other characters, excepting the two above mentioned, *Ægeon orientalis* agrees with *Ægeon cataphractus*.

General distribution :—Mediterranean, Senegambia, South Africa, Ceylon.

Family: PROCESSIDÆ.

Processa, Leach, 1815
(= Nika, Risso, 1816).

Processa canaliculata, Leach.

Processa canaliculata, Leach, 'Malac. Podoph. Brit.,' p. 641, 1815.
Nika edulis, Risso, 'Crustacés de Nice,' p. 85, 1816.
Nika canaliculata, Desmaret, 'Consid. gén. Crust.,' p. 231, 1825.
Nika bermudensis, Rankin, 'Ann. N.Y. Acad. Sci.,' XII., p. 536, 1900.

Localities :—Pearl banks, Gulf of Manaar (Station III.), 6 specimens; Muttuvaratu Paar (Station VI.), 1 specimen; 10 miles west of Cheval (Station XLVII.), 2 specimens; Cheval Paar (Station XLVIII.), 4 specimens; south-east of Modragam (Station LXIV.), 2 specimens.

None of these specimens appear to differ in any marked degree from the ordinary characters of the species.

General distribution :—Madeira, Japan, West Indies, Gulf of Mexico, South Africa, North-west Europe, Ceylon.

* J. R. Henderson, 'Trans. Linn. Soc.,' 2nd series (Zoology), vol. v., part 10, p. 446, and plate 40, figs. 16 and 17, 1893.

TRIBE: SCYLLARIDEA.

FAMILY: SCYLLARIDÆ.

Scyllarus, FABRICIUS, 1793 (= **Arctus**, DANA, 1852).

Scyllarus tuberculatus (SP. BATE).

Arctus tuberculatus, SP. BATE, '"Challenger" Macrura,' p. 70, 1888.

Localities:—Pearl banks, Gulf of Manaar (Station III.), 1 specimen, female; Galle (Station XXXV.), 3 females and 1 male; Aripu Reef (Station LXIV.), 1 specimen.

Characterised by large tuberculations on the mid-dorsal line of the carapace and of the first 3 pairs of abdominal segments. Those of the second abdominal segment are very distinctive of the species.

In this genus all the legs of the male end in a simple dactylos, and in the female there is a poor developed chela on each of the 5th legs. The propodite digit is not very well developed.

General distribution:—Australia and Ceylon.

Scyllarus sordidus (STIMPSON).

Arctus sordidus, STIMPSON, 'Proc. Acad. Nat. Sci., Phil.,' p. 8, 1860.

Locality:—Coral reef, Gulf of Manaar (Station LIV.), 3 females and 1 male.

General distribution:—Pacific and Ceylon.

TRIBE: THALASSINIDEA.

FAMILY: CALLIANASSIDÆ.

Callianassa, LEACH, 1813.

Callianassa rotundicaudata, STEBBING.

Callianassa rotundicaudata, STEBBING, 'Marine Invest. of S. Africa.' Crust., ii., p. 41, 1903.

Locality:—Cheval Paar (Station XLVIII.), 1 specimen, 18 millims. long.

General distribution:—South Africa, Ceylon.

Callianassa maldivensis, BORRADAILE.

Callianassa maldivensis, BORRADAILE, 'Fauna of Mald. and Lacc.,' vol. ii., part 3, p. 753.

Locality:—Gulf of Manaar (Station III.), 1 specimen, 24 millims. long.

This specimen is imperfect, but it agrees closely with the above species.

General distribution:—Maldives and Ceylon.

Upogebia, Leach, 1813.

Upogebia intermedia (de Man).

Gebiopsis intermedia, de Man, 'Journ. Linn. Soc.,' vol. 22 (Zool.), 1888.

Localities :—Haul 6, south of Adam's Bridge (Station LIV.), 2 males and 1 female; Muttuvaratu Paar (Station VI.), 1 male.

This species is characterised by the possession of a large number of denticulations on the cephalic portion of the carapace, and also by the anterior thoracic legs being richly clothed with long and very fine setæ.

The anterior portion of the carapace covers the small eyes and projects almost to the end of the antennular peduncle. The peduncle of the antennule is 3-jointed, the 3rd being slightly longer than the 1st and two and a half times as long as the 2nd. The 3rd joint is more slender than the other two. There are 2 flagella one and a half times as long as the peduncle. The inner flagellum is slightly longer and less robust than the outer. The antennal peduncle is slightly longer than that of the antennule and is also 3-jointed. The 1st and 2nd joints are equal and slightly longer than the 3rd joint, which is also less robust than the other two. The 1st and 2nd joints are richly clothed with long fine setæ. The eyes are small and project nearly to the end of the 2nd antennular peduncle. The middle of the carpos of the 1st legs reaches to the end of the rostrum. The appendages agree with de Man's description. The abdomen is large, being twice as long as the carapace and proportionally broad. The segments are subequal, the 2nd and 6th being slightly longer than the others. The telson is broader than long and equal in length to the uropods.

General distribution :—Mergui, Ceylon.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. *Penæus indicus*, MILNE-EDW., head, side view. × 4.
„ 2. *Parapenæus mogiensis*, RATHBUN, thelycum in Ceylon specimen. × 8.
„ 3. „ *gallensis*, n. sp., head, side view. × 5.
„ 3A. „ „ „ thelycum. × 4.
„ 3B. „ „ „ petasma. × 10.
„ 4. *Caradina vitiensis*, BORRADAILE, rostrum, side view. × 12.
„ 5. *Urocaris longicaudata*, STIMPSON, head, from above. × 7.
„ 5A. „ „ rostrum and carapace, side view. × 7.
„ 6. *Nauticaris grandirostris*, n. sp., side view. × 3.
„ 6A. „ „ rostrum, side view. × 3.
„ 6B. „ „ head, from above. × 5.
„ 6C. „ „ telson, from above. × 3.

PLATE II.

Fig. 7. *Latreutes ceylonensis*, n. sp., rostrum and anterior edge of carapace. × 65.
„ 7A. „ „ head, from above. × 65.
„ 7B. „ „ 3rd maxilliped. × 36.
„ 7C. „ „ 2nd thoracic leg. × 36.
„ 7D. „ „ 3rd thoracic leg. × 36.
„ 7E. „ „ telson, dorsal view. × 28.
„ 8. *Nauticaris futilirostris*, SP. BATE, 4th thoracic leg. × 30.
„ 9. *Synalpheus carinatus*, DE MAN, head, from above. × 12.
„ 9A. „ „ 3rd thoracic leg. × 54.
„ 9B. „ „ telson and right uropod. × 20.
„ 10. *Athanas orientalis*, n. sp., head, from above. × 30.
„ 10A. „ „ side of head. × 30.
„ 10B. „ „ 1st thoracic legs; small chela. × 25.

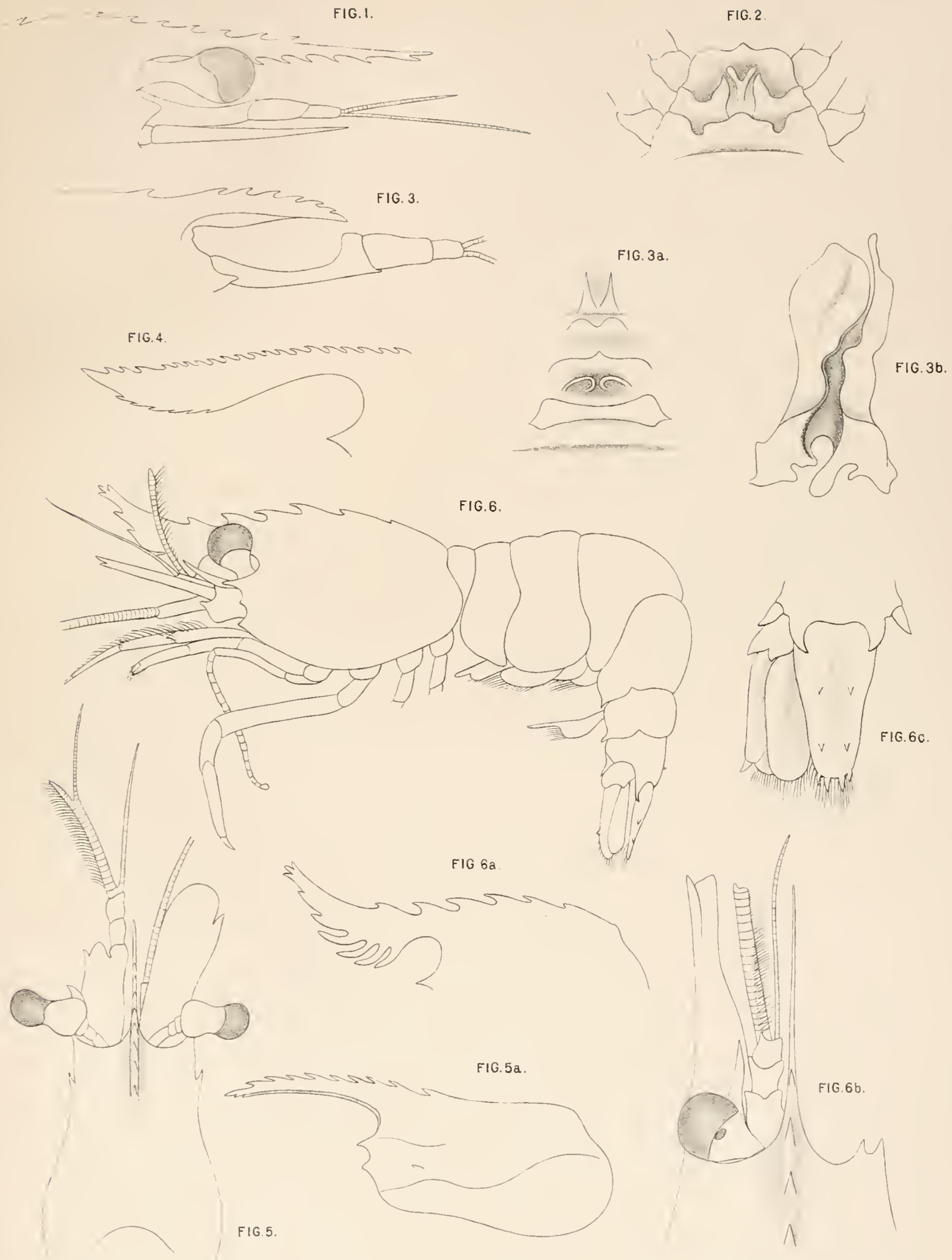


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FIG. 1, PENÆUS INDICUS, M. Edw.; FIG. 2, PARAPENÆUS MOGIENSIS, Rathbun; FIG. 3, PARAPENÆUS GALLENSIS, n. sp.; FIG. 4, CARADINA VITIENSIS, Borradaile; FIG. 5, UROCARIS LONGICAUDATA, Stimpson; FIG. 6, NAUTICARIS GRANDIROSTRIS, n. sp.;

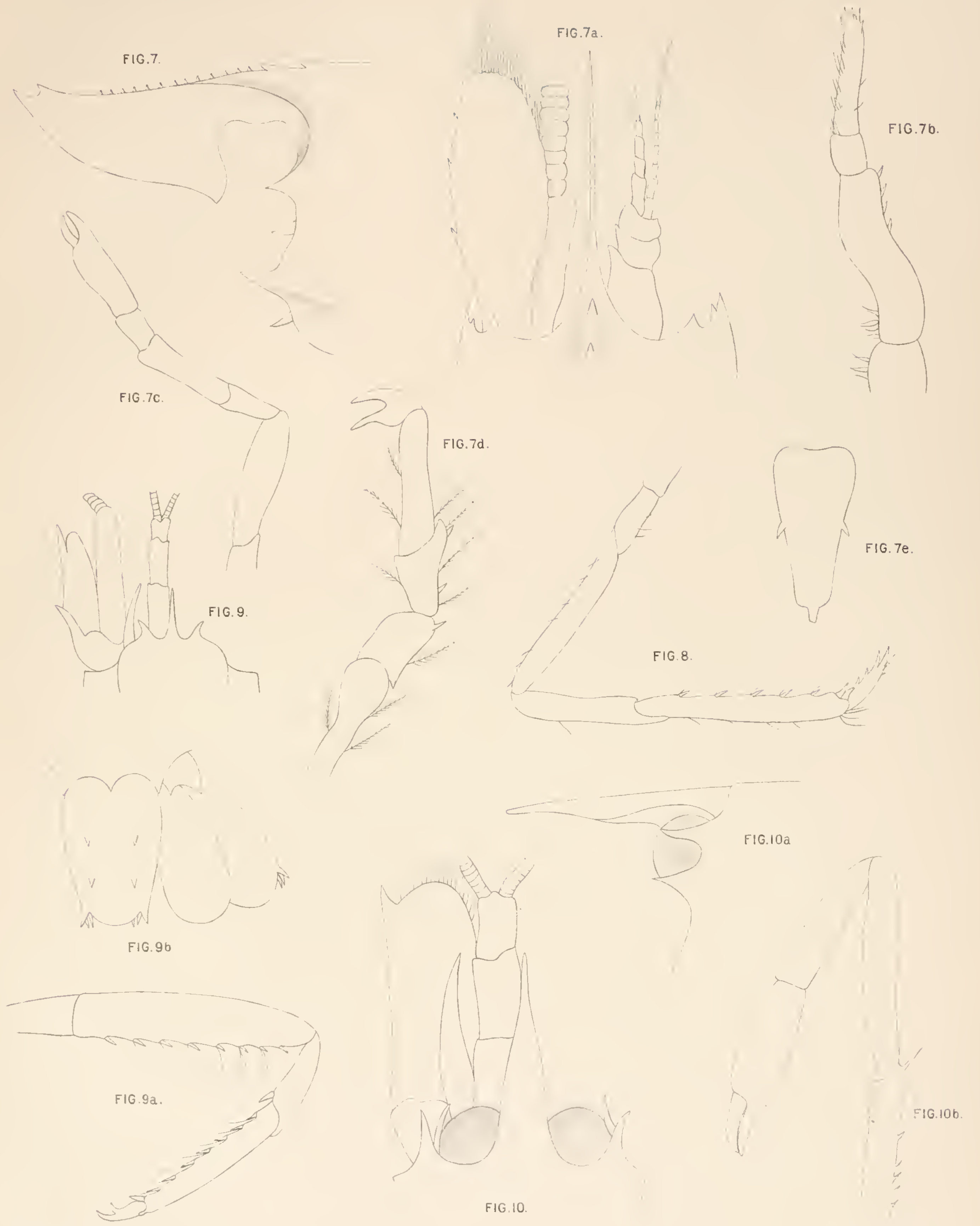

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FIG. 7, LATREUTES CEYLONENSIS, n. sp.; FIG. 8, NAUTICARIS FUTILIROSTRIS, Sp. Bate; FIG. 9, SYNALPHEUS CARINATUS, de Man; FIG. 10, ATHANAS ORIENTALIS, n. sp.

REPORT

ON THE

ANTIPATHARIA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

PROFESSOR J. ARTHUR THOMSON, M.A., UNIVERSITY OF ABERDEEN,

AND

JAMES J. SIMPSON, M.A., UNIVERSITY OF ABERDEEN.

[WITH ONE PLATE.]

THE collection of Ceylonese Antipatharians here reported on was made in 1902 from the Pearl Oyster Banks in the Gulf of Manaar, by dredging within the 100-fathom line off Trincomalee and off Galle. The localities are more precisely referred to in Professor HERDMAN'S "Narrative" in Part I. of the General Report (1903).

The collection is a small one, including thirteen species, but nine at least of these seem to be new. The list is as follows:—

FAMILY: ANTIPATHIDÆ.

SUB-FAMILY: CIRRIPATHINÆ.

**Cirripathes* (?), n. sp.

SUB-FAMILY: ANTIPATHINÆ.

**Antipathes gallensis*, n. sp.
**Antipathes gracilis*, n. sp.†
Antipathes abies, GRAY.
**Stichopathes ceylonensis*, n. sp.
**Stichopathes contorta*, n. sp.
**Stichopathes papillosa*, n. sp.
Stichopathes gracilis, GRAY, var. *spiralis*, nov.
Stichopathes echinulata, BROOK.
**Antipathella rugosa*, n. sp.
**Antipathella elegans*, n. sp.
**Antipathella irregularis*, n. sp.
**Antipathella ceylonensis*, n. sp.

* Those marked with an asterisk are reported as new.
† NON *Antipathes gracilis*, GRAY (1860) = *Antipathella gracilis*, GRAY;
NON *Antipathes gracilis*, KOCH (1889) = *Antipathes mediterranea*, BROOK (1889).

Before proceeding to the systematic report, we would make a few general observations:—

(*a*) In the detailed classification of Antipatharia much importance has been attached to the form and distribution of the spines on the axis. But it does not seem to have been sufficiently emphasised that there is considerable variation in both of these characters in the different parts of the colony. Thus in the branched forms the nature of the spines, the number seen from one aspect, and the arrangement of these in spirals or longitudinal rows in no way correspond on the larger branches and on the pinnules (Plate, fig. 2). In the simple colonies this is even more emphasised, *e.g.*, in *Cirripathes* (?) (Plate, fig. 8) those at the base are arranged irregularly (*a*), those about the middle of the colony have a distinct linear arrangement (*b*), while those near the tip are disposed in whorls around the stem (*c*). This distinction has been illustrated relative to the species described, in the figures on the Plate, where two views, and in one case three, have been given. This is of great importance where species are determined from fragmentary specimens.

(*b*) This difference between stem, branches, and pinnules is also borne out with regard to the size and shape of the polyps. In many of the specimens, on the stem and larger branches, the polyps are almost circular and disposed irregularly, their diameter being less than that of the axis, while on the pinnules they are elongated and rectangular, exceeding in breadth the diameter of the axis. Their distribution also varies in the different portions of the colony; they are often separated by considerable intervals on the older parts, while on the pinnules they may be closely apposed. The length and degree of transparency of the tentacles does not seem to be a safe criterion, varying as it does with the degree of contraction and the mode of preservation.

(*c*) Of some general interest and deserving further investigation is the extraordinary modification shown in the spines of several species. The general Antipatharian spine is simple or papillose, but in some species they pass from an elongated sinuous form through a series of gradations to an antler-like growth and eventually simulate a tree-like structure (Plate, fig. 1, *a–f*). This has been previously noted, *e.g.*, by CARTER for *Antipathes spinosa* (CARTER), but no interpretation has been suggested. It may be due to a pathological condition, and in some cases where branched spines were observed it was noted that a sponge-like growth surrounded the axis, or it may be the result of irregular regeneration of broken spines. It is particularly well seen at the base of *Antipathes gracilis*, n. sp., and on *Antipathella rugosa*, n. sp. In *Antipathes abies*, GRAY, a forking of the spines was occasionally observed.

(*d*) The polyps of *Antipathes abies*, GRAY, which were unknown when Mr. GEORGE BROOK described the "Challenger" Antipatharia, are very well preserved in some of HERDMAN'S specimens, and we have therefore given a full description and figures of their external features (Plate, fig. 4).

(e) A fact which may yet prove to be of some importance is that in *Stichopathes papillosa*, n. sp., belonging to a genus typically simple, a knob-like projection, about 6 centims. from the base, indicates, without doubt, the remains of a branch.

(*f*) The various specimens show a considerable number of epizoic animals:—*e.g.*, Sponges, Polyzoa, Serpula-tubes, Spirorbis-tubes, Cirripede-galls, stalked Barnacles, Corals, and in one case a young pearl oyster.

Cirripathes (?) n. sp.—Plate, fig. 8.

A very large simple colony, 135 centims. long, with a diameter varying from 3·75 millims. at the base to 0·75 millim. at the top. The basal portion, which is attached to a stone, is expanded into a circular disc 16 millims. in diameter. The stem is sinuous for the first 35 centims., but after that it is coiled into three distinct spirals, with diameters of 10 centims., 9 centims., and 8 centims. respectively—the corresponding heights being 10 centims., 8 centims., and 7 centims. The total height of the colony is 65 centims. The colour of the axis at the base is jet black, changing gradually to a golden brown. It is hollow, at least in the upper region, and is covered with distinctly papillose spines, which are 0·1 millim. in height near the top of the colony, but shorter and thicker further down. They are arranged irregularly near the base, where twenty can be counted from one aspect, but further up a linear arrangement seems to predominate. Near the top they are disposed in verticils round the stem, about one and a half to two lengths apart, and the number from one aspect diminishes to nine. They are of a paler colour than the stem.

As there are no polyps on the specimen, it is impossible to decide its position with security, beyond saying that it is either a *Stichopathes* or a *Cirripathes*, but the arrangement of the spines and the general nature of the colony would point towards its being a new species of *Cirripathes*, which we would refrain from naming. The specimen was trawled at Station XXIV., off Foul Point, outside Trincomalee, 46 fathoms.

Antipathes gallensis, n. sp.—Plate, fig. 15.

A fragmentary portion of a colony, 8 centims. high and 4·5 centims. broad. The branching is irregular, giving the whole a shrub-like appearance, suggestive of the broom. The main stem is short and sinuous, but a large branch arises about midway up and constitutes the greater part of the colony. The general colour is black towards the base, but rusty brown in the smaller branches, which are long and slightly flexed. The diameter of the axis is 1 millim. at the base and tapers very gradually.

The spines on the main branch are low and conical, standing perpendicularly and arranged irregularly, so that no definite number could be counted from any one aspect. Those on the smaller branches are compressed and thorn-like—the upper

margin being sub-horizontal, while the lower is convex. They are comparatively short, about one-third the diameter of the branch, and are disposed in fairly steep sinistrorse spirals and longitudinal rows, those in a row being about two lengths apart. The rows do not consistently alternate, but a quincuncial arrangement is infrequent. Five can be clearly seen from one aspect, while the tip of another is visible, seven making a complete revolution.

The polyps on the stem are large and circular, with a low truncated oral cone and prominent mouth opening, which is also circular. The tentacles are arranged radially and slightly distant on the branches, the polyps are arranged in a single longitudinal row and are elongated in the direction of the axis—this being specially marked on the smaller branchlets. They are very large and prominent, measuring 1·5 millims. in length. The projection bearing the circular oral opening is large and cylindrical. The tentacles when fully expanded are very long, but in most of the polyps they are contracted—being then thick set and conical. They are disposed in three pairs, the sagittal pair being inserted low down in the polyp. On the larger branches the distance between the polyps is equal to about one-half their length, but this diminishes considerably on the branchlets, where the polyps are more elongated though still of the same general character.

This species differs from any known form both in its mode of branching and in the arrangement of the spines.

Locality :—Station XLI., deep water off Galle.

Antipathes gracilis, n. sp.—Plate, figs. 7 and 14.

A small, complete, delicate whip-like colony, 6 centims. high and 1 centim. in diameter, attached by a small expansion. It consists of a main axis, 1 millim. in diameter at the base, tapering gradually to a fine point. The lower 13 millims. of the stem are devoid of branches. On the next 2 centims. small branches bearing pinnules arise sub-horizontally from three sides. These are almost straight and taper to a point, the longest being 8 millims. The remainder of the stem bears branches arising on all sides, but apparently in no definite order. The branches gradually diminish in length towards the apex of the colony. The colour of the axis is golden yellow when seen with transmitted light.

The spines on the bare part of the axis are slightly elongated, compressed, and triangular, the upper margin being sub-horizontal, the lower convex. They are arranged irregularly, about nine being visible from one aspect, at intervals of about one length. Many of the basal spines show an antler-like or dendriform mode of branching. On the upper part of the stem they are disposed in more regular longitudinal lines, five being now visible from one aspect. On the pinnules they are still of the same type, but more elongated, and with a greater slope towards the axis. They seem to be arranged irregularly, but a closer examination reveals a hint of a

steep dextrorse spiral. They are about one and a half lengths apart, and seven is a typical number from one aspect.

The polyps are all arranged so as to face in one direction, and it is worthy of note that this is away from the bare portion of the axis mentioned before. On the stem they are disposed irregularly and are somewhat circular, the tentacles being inserted almost equidistant from the mouth opening. The oral projection is very prominent and cylindrical, and the mouth opening is circular. On the branches and pinnules they are very much elongated, and the tentacles are disposed in three pairs, the sagittal pair being inserted slightly below the level of the others; but apart from this the structure is much the same as in those on the stem. On the branches they are separated by intervals about equal to their breadth, but on the pinnules this distinct demarcation disappears.

This species approaches most closely to *Antipathes spinosa* (Carter) (*Hydradendrium spinosum*, Carter), but differs from it both in the mode of branching and in the character of the spines. In *A. spinosa* (Carter) the polyps had not been observed when Mr. Brook described the "Challenger" Antipatharia.

Locality :—Deep water off Galle.

Antipathes abies, Gray—Plate, fig. 4.

Several very fine specimens of this species are included in the Ceylon collection. All are of the bottle-brush, or, more correctly, fir-tree type.

One magnificent colony (A) is 65 centims. in height, the breadth varying at the different parts. At 20 centims. from the base the diameter is 15 centims., but this gradually diminishes to 10 centims. at 40 centims. from the base, and tapers almost to a point at the top of the colony. It is attached to a stone, and for the first 11 centims. the axis is bare. Above this there are about a hundred principal branches of varying sizes. The colour of the axis is black, but owing to the thin cœnenchyma it presents a greyish surface. The branches have a superficial rusty or reddish-brown tint, getting paler towards the top of the colony. The diameter of the axis at the base is 5 millims.; it gradually tapers upwards.

A smaller colony (B) is also very perfect and compact. It is 30 centims. high and 15 centims. in diameter about half way up. From that point it ascends in a symmetrical cone. From the first 9 centims. of the stem the branches have been broken off, but the knob-like ends have been quite overgrown by the cœnenchyma.

The axis is 7 millims. in diameter at the base and tapers to a point. The colour is identical with that of (A).

The main stem is slightly curved and the branches are longest on the concave surface, so that in contour the colony is symmetrical.

The mode of branching is by no means regular. At some places there are signs of a spiral arrangement, but this is often interrupted by extra offshoots. The branches arise very close together, often only 2 millims. apart. They are mostly in planes at

right angles to the main stem, but some are turned upwards and others downwards, interlocking, so that no two overlap. At their point of origin they are about 2 millims. in diameter and present the crescentic shape characteristic of the species. A typical branch from the concave side of the stem has a chord of 10 centims., a perpendicular height of 2 centims., and a breadth of 5 centims. The branches bear branchlets, and even secondary and tertiary branchlets, extending in a plane at right angles to the long axis of the branch. The secondary branches arise in a distinctly alternate manner, the planes bearing them enclosing an angle of 60°. The branches do not all curve in one direction, but for the most part they diverge in pairs, so that the tips of two approximate, enclosing an ellipse. The secondary branches arise in a similar manner, so that the maximum of surface is exposed on the contour of the colony.

The spines vary greatly in the different parts of the colony. On the black main stem they are disposed very irregularly, and are very small and abundant. This is also the case on the paler branches, and owing to the conical form the whole gives the impression of a moss-rose stem. They are horny in colour and have a black broadened part where they arise from the stem. The smaller branchlets are transparent and hollow, being of a golden-brown colour with a faint reddish tinge. Here the spines are much longer, being bluntly conical and pointing slightly upwards. They are arranged in distinct longitudinal lines, which in reality are the result of steep sinistrorse spirals, five or six being seen from one aspect. They are almost equal to the radius of the pinnule and are about one length apart.

The polyps, which were unknown when Mr. Brook described the "Challenger" Antipatharia, are of two kinds, according to the position in the colony. On the main stem and larger branches they are scattered irregularly on the concave surface, being thus within the general network of the circumference. They are visible to the naked eye and appear as six-rayed stars. They are almost circular, the tentacles being disposed on six radii. The tentacles vary considerably in size, according to the state of retraction. On the pinnules the polyps are arranged on the convex surface and thus all face outwards. They are more rectangular in shape than on the stem, being elongated in the direction of the long axis of the pinnule. The tentacles are disposed in three pairs, those in the sagittal axis being inserted very far down and standing mostly perpendicular to the polyp. The distance between the polyps is approximately the same as the length of a polyp, viz., 0·9 millim. In all cases the mouth is situated on a prominent cylindrical projection, the oral cavity being elongated in the direction of the sagittal axis.

Cirripede galls are of frequent occurrence, and these are overgrown with the mud-coloured cœnenchyma, also bearing spines. Numerous barnacles are attached to the larger branches.

Another almost complete colony (C), without the basal attachment, is 22 centims. in height and 9 centims. in diameter at the widest portion. The main stem is bent

so as to form two arcs. The length of the branches on the concave surface of the stem greatly exceeds that on the convex, so that the contour is symmetrical.

The spines are typical both as to size and arrangement. A few are bifurcated, but as this is only of local occurrence it does not justify the dignity of a new species. The polyps are also typical, but in some, owing to contraction, the tentacles are very inconspicuous.

A beautiful complete colony (D), closely resembling a young larch tree, was attached to a stone by a disc-like expansion. It is 30 centims. in height, the greatest width being 10 centims. The first 10 centims. are bare, owing to the branches having been broken off, and the next 6 centims. bear branches only on one side. The diameter of the axis at the base is 2 millims. The spines and polyps are typical. A great number of barnacles are attached to the branches.

Another complete colony (E) was more of the bottle-brush type. It is 13·5 centims. high, with branches down to the very base—breadth 6·5 centims. The diameter of the axis at the base is 1·5 millims., tapering to 0·5 millim. The branching is not so regular as in the others, but in no case do the branches overlap. The spines and polyps agree closely with the typical forms, but the colour of the branches is slightly darker.

Localities :—Station LXIII., west of Periya Paar, in the Gulf of Manaar, 40 fathoms ; and Station XXIV., off Foul Point, outside Trincomalee, 46 fathoms.

Stichopathes ceylonensis, n. sp.—Plate, fig. 9.

A small, complete, simple colony attached to a piece of stone by an almost spherical expansion. It is 8·5 centims. long, but only reaches a height of 6 centims. owing to its spiral course.

The diameter at the base is 1 millim., and this diminishes to 0·75 millim. at the tip of the colony, so that the tapering is very slight. The stem is translucent, golden brown near the base, becoming paler upwards ; it is hollow throughout its entire length. The first 4 centims. are straight, followed by two open sinistrorse spirals 1·3 centims. in diameter.

The spines near the base are short, triangular, and compressed, standing at right angles to the stem, disposed irregularly, but mostly one to two lengths apart. Four may be seen from one aspect. On the upper half of the colony the spines are of the same type, but considerably longer in proportion to the thickness of the stem, being equal to about one-third of the diameter. They are arranged in steep sinistrorse spirals and longitudinal rows about two to three lengths apart. Four can be distinctly seen from one aspect, while the tips of two others are visible, so that there are eight altogether in a spiral.

The polyps are typical and prominent. The tentacles are very long and transparent, and the sagittal pair are inserted almost diametrically opposite. They are separated by a distance of about one-half the length of a polyp. Towards the top of the colony

they are alternately large and small—the smaller forms being probably younger. They are also separated by greater intervals.

This specimen comes nearest to *S. pourtalesi*, Brook, but cannot be identified with it. It differs, for instance, in not having "crowded" polyps, and the arrangement of the spines is also different.

Locality :—Station LV., outside the pearl banks, Gulf of Manaar.

Stichopathes contorta, n. sp.—Plate, fig. 3.

A simple slender colony, 40 centims. long, attached to a piece of rock. It is very sinuous, growing first upwards, then coiling and turning downwards, again twisting and starting on an upward course. Thus the total height is only 7 centims., and the growing point is but 3 centims. above the base. The diameter of the axis is 1 millim. and is uniform throughout. The colour is blackish with a brown tinge, the axis is hollow down to the disc of attachment.

The spines are of a pale horny colour, and are slightly but distinctly papillose. They are arranged in longitudinal rows in the lower portion about two to two and a half lengths apart, seven being seen from one aspect. Further up, a distinct steep spiral arrangement may be seen—seven being required to form one revolution. Those in one longitudinal row are about two lengths apart.

The polyps are arranged on one side of the axis at intervals of about 1 millim., which is also the length of a polyp.

The oral cone is prominent and the mouth opening circular. The tentacles are about 0·5 millim. in length even in a contracted state. Young polyps are frequent between the larger older forms.

This species is nearest *S. lutkeni* (Brook), but differs from it both in the number and arrangement of the spines.

Locality :—From off Galle and onwards up West Coast of Ceylon.

Stichopathes papillosa, n. sp.—Plate, figs. 6 and 13.

A complete, simple, robust colony attached to a piece of rock. It is 38 centims. long and attains a height of 18 centims.

The first 4 centims. are almost straight, the remainder coiled into ten distinct dextrorse spirals, 13 millims. in diameter and averaging 14 millims. high. The axis is 1·25 millims. in diameter at the base and tapers gradually to 0·5 millim. at the top. At a distance of 6 centims. from the base there is a projection which indicates the remains of a branch. The colour is black at the lower part, becoming lighter towards the apex.

The spines are slightly but distinctly papillose, and vary in number in the different parts of the colony; thus at the base fourteen can be counted from one aspect, whereas at the top only ten and points of two are visible. Those near the base are conical and covered throughout their whole length with small papillæ, but on the upper part of

the colony the papillæ are confined to the apex of the spines, which in this region are more flattened and triangular. They are arranged in distinct dextrorse spirals, and are about one length apart.

The cœnenchyma is very thick on the side devoid of polyps.

The polyps are about 1 millim. in diameter and almost form a square—the directive tentacles being inserted at the corners and the sagittal pair at a slightly lower level. The tentacles are very long when expanded, but on contraction form low, broad cones. The oral cavity is large and elliptical, being elongated transversely. The oral cone is large and prominent. The polyps in the upper part of the colony are close together, but lower down they are separated by a distinct groove. Smaller polyps, probably young forms, are of not infrequent occurrence.

The lower part of the stem is covered with Polyzoa.

The distinctive features of this new species are: the thickness of the cœnenchyma, the papillose character of the spines, together with the dextrorse spiral arrangement, and the distance between the spines as compared with their length.

Locality:—Deep water off Galle and onwards up West Coast of Ceylon.

Stichopathes gracilis, Gray, var. **spiralis**, nov.

A very slender, simple colony, 58 centims. in length. Owing to its sinuous and spiral course, it only attains a height of 20 centims. It is attached by a broadened basal expansion. The first 5 centims. are straight; succeeding this there is a sinuous portion 17 centims. long, followed by two distinct spirals 6 centims. in diameter and about 6 centims. high. The diameter at the base of the stem is 1 millim. and this measurement scarcely diminishes even at the tip. The colour appears black, but when viewed with transmitted light has a decided reddish-brown tinge. The stem is hollow to the very base.

The spines near the base are very much damaged, but appear to be short, somewhat flattened cones, irregularly arranged, a comparatively small number (about 5) being visible from one aspect. About the middle portion of the colony they are short and triangular, standing perpendicularly to the axis, and disposed in irregular longitudinal rows and dextrorse spirals. The spines in a longitudinal row are separated by about two lengths. Six can be counted from one aspect.

Near the top of the colony the spines are much smaller and inclined to the axis, the upper margin being concave and the lower convex. They are arranged in very steep dextrorse spirals, nine in one spiral being seen from one aspect.

The distance between any two varies greatly—from two to four lengths. The polyps are arranged in a single longitudinal row, and are very large and prominent, measuring about 2 millims. in length. They are slightly elongated, the oral cone being low but distinct. The tentacles are disposed in three pairs, the sagittal pair being inserted at a considerably lower level than the others. They are very long when fully expanded, but when contracted are low, broad and conical; others are

like large spheres with a small filiform projection. They arise from somewhat spherical bases. The polyps are separated by a very small interval, but an annular constriction between each pair seems to pass round the stem.

This specimen agrees on the whole with *Stichopathes gracilis*, but as it differs in some details regarding the spines, and conspicuously in having a spiral course, it has seemed convenient to name a new variety.

Locality :—Deep water off Galle.

Stichopathes echinulata, Brook.

This species is represented by a simple colony, incomplete at the base, 26 centims. long, very irregular and sinuous, so that the total height is only 8 centims. The growing point is turned downwards and is only 5 centims. above the lowest portion. The colony tapers very markedly from 1·5 millims. to 0·5 millim. The colour of the axis is almost black.

The spines are very short, compressed and directed upwards. They are arranged in very steep spirals, the distance between two rows being almost the same as that between any two on a spiral, so that they show a quincunx grouping. The distance between any two is equal to about four lengths of a spine.

The polyps are typical, but the sagittal tentacles are relatively distant from the oral cone. They are separated by a distance about two-thirds of the length of the polyp.

This species has been previously recorded from Mauritius.

Locality :—Station LX., outside the pearl banks, Gulf of Manaar.

Antipathella rugosa, n. sp.—Plate, figs. 5 and 11.

There are two specimens of this new species in the collection, both slightly damaged. The larger of these is 19 centims. high and 13 centims. broad. It is branched mostly in one plane, and consists of two main branches which arise dichotomously from a short main stem 1 centim. long. One branch arises at 60°, while the second after a short distance at right angles to the stem bends upwards and runs closely parallel to it. The first is broken off about 7·5 centims. from its origin, and the second at a slightly lower level. At the point of fracture large secondary branches are given off, and it is noteworthy that the angles of inclination are the same as for the first two, viz., 60° and 90°. The primary and secondary branches give off pinnæ in a strictly alternate manner, and these again bear pinnules. The pinnæ converge slightly. The whole plane of branching is slightly curved and the polyps arise on the convex surface.

Near the base the axis is opaque and black in colour, but this passes gradually into a transparent horny yellow in the upper parts of the colony. The smaller branches and pinnules are hollow.

The spines on the large branches are short and slender, tapering in a marked

degree. They are slightly inclined to the axis, and are arranged irregularly, about fifteen being visible from one aspect. Those on the pinnules are very thin and delicate, fairly long, conical in shape, and inclined to the axis at an acute angle. They are arranged in distinct longitudinal lines which are the expression of steep dextrorse spirals. Five can be seen from one aspect. The distance between two in a longitudinal line is equal to about two lengths.

On the main branches the polyps are arranged irregularly, and are almost circular, the tentacles, which are moderately long, being equidistant from the oral cavity. On the pinnules the polyps are arranged on the convex surface and are elongated in the direction of the axis. The distance between the polyps varies. In some places they are crowded together, while in others they are separated by a distance equal to their breadth. In all cases the body of the polyp is large. The oral cavity is circular and borne on a very prominent cylindrical projection. The tentacles are large and inclined outwards, being very rugose in appearance, due probably to the state of retraction. They are arranged in three rows of two each—the sagittal tentacles being inserted far down.

The colony bears numerous epizoic animals :—Cirriped galls and stalked barnacles, tubes of *Spirorbis*, several Polyzoa, a Sponge, and a young pearl oyster shell. It is worthy of note that the majority of these are overgrown by the cœnenchyma and bear both polyps and spines.

A second specimen of this species—also slightly damaged—is 14·5 centims. in height and 8 centims. in breadth. It consists of a main stem with a basal attachment from which three branches arise on one side at about 60°. These are slightly arched, and the longest, which is 12 centims. in length, has a diameter of 1 millim., tapering to a point. The whole colony is flabellate. In its spines, polyps, and colour it agrees with the other specimen.

This species should be included in Brook's Group A ("Challenger" Report), but it does not approach closely to any of species already included in that group.

Localities :—Deep water off Galle, and Station VIII., deep water, in Gulf of Manaar.

Antipathella elegans, n. sp.—Plate, fig. 10.

A complete, very graceful colony, 13 centims. in height, with a maximum breadth of 5·5 centims. at a distance of 9·5 centims. from the base, which is expanded into a disc-like attachment. At a distance of 3 centims. from the base the main stem bifurcates and the two subsidiaries develop almost equally. The mode of branching is not uniform. The general appearance is dichotomous, but this breaks down in several places where three or four branches arise on one side. The stem and branches are black at the base, gradually passing into golden brown near the apex. All the branches and pinnules are hollow. The diameter of the branches varies very little in the different parts, and the gentle tapering gives the whole colony a very graceful appearance. The axis is 1 millim. in diameter at the base. The spines are short and

very much compressed, being somewhat triangular with a very broad base. The upper margin is sub-horizontal, while the lower is convex. They are arranged in very steep sinistrorse spirals and longitudinal rows, the distance between two in a row being four lengths, while that between two in a spiral is one length. From one aspect five can be seen quite distinctly along with the tips of other two, making in all eight spines in a circumference. The spines near the base are shorter, smaller and more conical. They are disposed in sinistrorse spirals and distinct rows, the distance between two in a row being about four lengths.

The polyps are typical. They are situated in a single row on the branches and branchlets, and are very much elongated in the direction of the axis. The distance between the polyps varies in the different parts; they are in some places close together, in others separated by intervals equal to half their length. Very often a line passing through the oral cones is a line of spines, and the polyps occupy a length corresponding to four spines in a longitudinal row. The oral cone is very prominent and the mouth opening is circular. The tentacles vary in different parts according to their state of contraction. The sagittal pair are inserted rather far down, corresponding to spines 1 and 5 on a circumference. In some cases the tentacles have spherical terminations.

This species is chiefly distinguished by the nature and arrangement of the spines, which are markedly different from those of other species, but also by the polyps, which, though typical of the genus, nevertheless bear specific characters.

Locality :—Station LX., outside pearl banks, Gulf of Manaar.

Antipathella irregularis, n. sp.—Plate, fig. 12.

This species is represented by a small complete colony and a fragment. The former is 4 centims. in height and 6 centims. in breadth, the general shape being sub-flabelliform. The branches arise mostly in two planes, but occasionally in a third, leaving one quadrant bare. Frequent fusions occur.

The other specimen consists of a short main stem with a disc of attachment at the base. The stem is only 2 centims. high, and the axis tapers from 1 millim. at the base to a very fine point at the apex. The branches are longer than the main stem and constitute the greater part of the colony. They arise on three sides at a very large angle, so that the expansion is mostly lateral.

The colour of the axis near the base is black, but it passes through a dark amber to a horny yellow in the branchlets. The secondary branches are somewhat elongate and slender and appear slightly flabellate.

The spines near the base of the stem are short, conical, and irregularly disposed; but on the branches a definite arrangement can be traced. There they are compressed and triangular in form, arranged sometimes in a dextrorse and sometimes in a sinistrorse spiral. They are about two lengths apart and five can be seen from one aspect.

The polyps are rather small and are disposed on one side of the stem and branches, so that none appear on the quadrant devoid of branches. They are oval in shape, being elongated in the direction of the axis. The oral cone is low but definite; the mouth is scarcely discernible. The tentacles are comparatively long and delicate, having a broad base and tapering markedly. The distance between the polyps varies, but in most cases there is a valley-like depression between them, giving the surface an undulating appearance.

The distinctive features of the species are the irregular mode of branching, the character and arrangement of the spines, and the nature of the polyps.

Locality:—Station XXIV., off Foul Point, outside Trincomalee, 46 fathoms.

Antipathella ceylonensis, n. sp.—Plate, fig. 2.

Of this species there are two specimens—one complete colony and a broken part of another.

The former is a small, graceful, delicate colony, complete but for the tips of some of the branches. It is 7 centims. in height and 5 centims. in breadth. The main stem is 5 centims. long, and the axis is about 1 millim. in diameter above the disc of attachment, which is 1 centim. broad. The branching is approximately in one plane, and there are signs of fusion in three places. About 1 centim. from the base two branches arise, almost of the same diameter as the main stem. One of these is 4 centims. long, the other is 6 centims. and bears a comparatively large secondary branch. The branching is irregular, but nearly alternate. The branchlets are very slender and arise at different angles, very seldom at an angle less than 60°, and most frequently at right angles.

The spines near the base are short, conical, and distant; those on the pinnules are larger and thorn-like, the lower margin of the compressed triangle being convex. They are equal to about half the diameter of the pinnule and are about three lengths apart. The arrangement is in steep sinistrorse spirals, four being seen from one aspect.

The polyps are disposed on one side of the branches and are elongated in the direction of the long axis. The tentacles are short and are arranged in three pairs, the sagittal pair being inserted at a level slightly lower than the others. The oral opening is circular, and is elevated on a prominent cylindrical projection.

This species comes nearest to *A. tristis* (Duch.), but is distinguishable from it both in spines and polyps.

Locality:—Station XXIV., off Foul Point, outside Trincomalee, 46 fathoms.

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EXPLANATION OF THE PLATE.

Fig. 1. *Antipathella rugosa*, n. sp., dendriform spines, *a–f*, different stages of growth.

,, 2. *Antipathella ceylonensis*, n. sp., arrangement of spines.
(*a*) Main axis; (*b*) Axis of pinnule.

,, 3. *Stichopathes contorta*, n. sp., arrangement of spines.
(*a*) Near base of the colony; (*b*) Towards the tip of the colony.

,, 4. *Antipathes abies*, Gray, polyps.
(*a*) On main branches; (*b*) On axis.

,, 5. *Antipathella rugosa*, n. sp., polyps on pinnules.

,, 6. *Stichopathes papillosa*, n. sp., polyps near the tip of the colony.

,, 7. *Antipathes gracilis*, n. sp., complete colony. Nat. size.

,, 8. *Cirripathes* (?), n. sp., arrangement of spines.
(*a*) Near base of colony; (*b*) Middle of colony: (*c*) Near tip of colony.

,, 9. *Stichopathes ceylonensis*, n. sp., arrangement of spines.
(*a*) Near base of colony; (*b*) Towards top of colony.

,, 10. *Antipathella elegans*, n. sp., arrangement of spines.
(*a*) Lower part of axis; (*b*) Near top of axis.

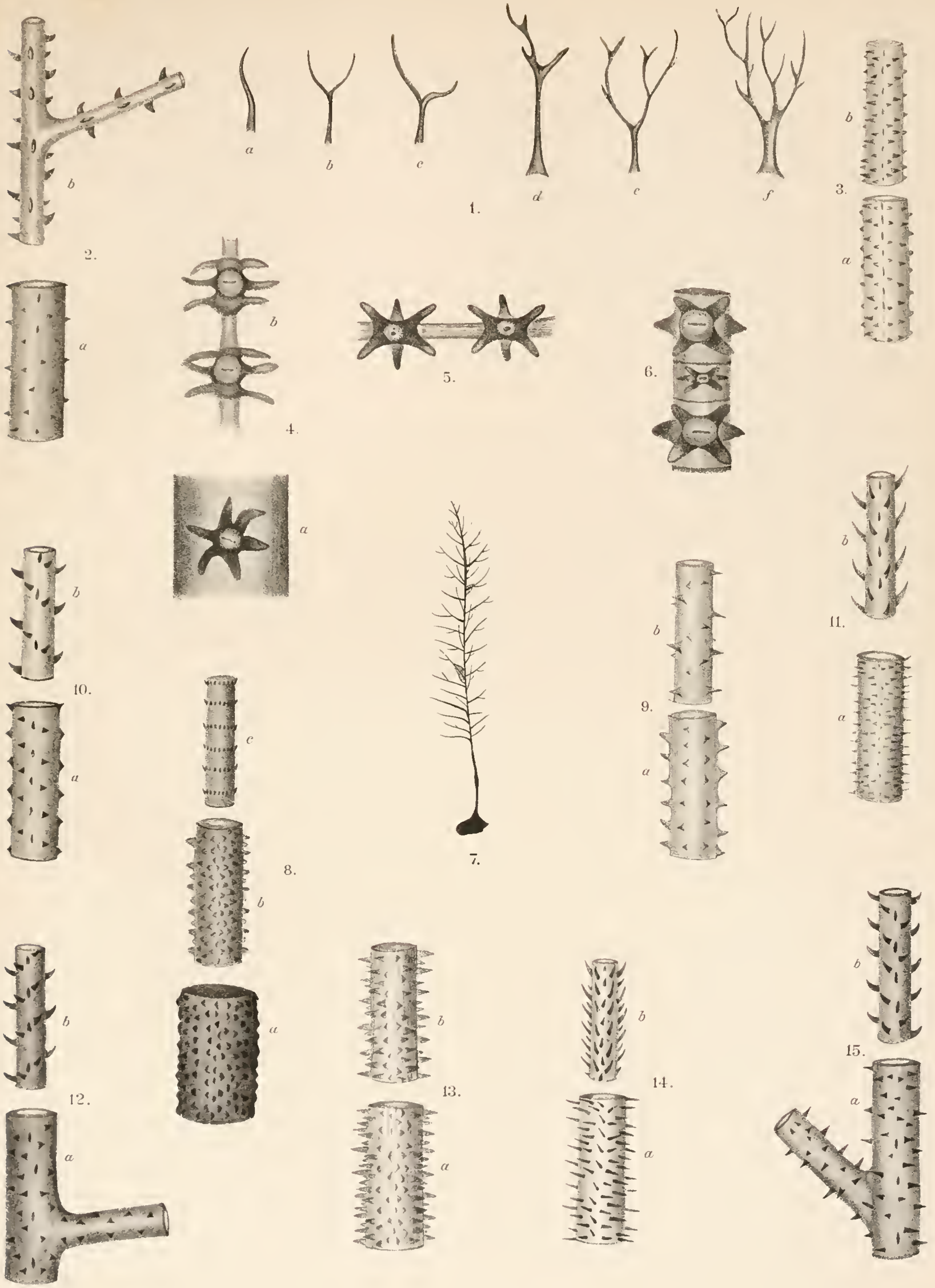
,, 11. *Antipathella rugosa*, n. sp., arrangement of spines.
(*a*) Near base of main stem; (*b*) Part of a pinnule.

,, 12. *Antipathella irregularis*, n. sp., arrangement of spines.
(*a*) Main stem and branch; (*b*) Pinnule.

,, 13. *Stichopathes papillosa*, n. sp., arrangement of spines.
(*a*) Near the base of the axis; (*b*) At the tip of the axis.

,, 14. *Antipathes gracilis*, n. sp., arrangement of spines.
(*a*) On main stem; (*b*) Part of a pinnule.

,, 15. *Antipathes gallensis*, n. sp., arrangement of spines.
(*a*) Main stem and branch; (*b*) Pinnule.



Jas. J. Simpson del. E Wilson, Cambridge

Fig. 1, Antipathella rugosa, n. sp.; Fig. 2, Antipathella ceylonensis, n. sp.; Fig. 3, Stichopathes contorta, n. sp.; Fig. 4, Antipathes abies, Gray; Figs. 5 and 11, Antipathella rugosa, n. sp.; Figs. 6 and 13, Stichopathes papillosa, n. sp.; Figs. 7 and 14, Antipathes gracilis, n. sp.; Fig. 8, Cirripathes, n. sp.; Fig. 9, Stichopathes ceylonensis, n. sp.; Fig. 10, Antipathella elegans, n. sp.; Fig. 12, Antipathella irregularis, n. sp.; Fig. 15, Antipathes gallensis, n. sp.

REPORT

ON THE

POLYZOA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

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[WITH ONE PLATE.]

INTRODUCTORY.

THERE are at least 116 species of Polyzoa in this collection from Ceylon. Of these, 31 had already been found in Indian seas, 32 of the remainder have been reported from Australian waters, 13 from the China Sea, and several from neighbouring but outlying waters to the east, west, and south of the Indian Ocean. Of the rest, some have not been, I believe, recorded from nearer than Florida (7 species), the Queen Charlotte Islands (1), and the Mediterranean Sea (2). Several are cosmopolitan in their distribution, and 19 are British species. Finally there are 16 species and 1 variety which I consider to be new, and which will be described below as :—

Onychocella cucullata, n. sp.
Schizoporella avicularis, n. sp.
„ *viridis*, n. sp.
„ *collaris*, n. sp.
Rhyncopora incisor, n. sp.
„ *corrugata*, n. sp.
Gemellipora protrusa, n. sp.
Lepralia multidentata, n. sp.
„ *purpurea*, n. sp.
Lepralia nitida, n. sp.
„ *ceylonica*, n. sp.
„ *fissa*, n. sp.
„ *triangula*, n. sp.
Smittia trispinosa, var. *protecta*, n.
Phylactella spiralis, n. sp.
Retepora pocillum, n. sp.
Cellepora compacta, n. sp.

Polyzoa are well distributed round the coast of Ceylon. No less than 89 species were found in the Gulf of Manaar, and 32 off Galle. Many of them were obtained in

several distinct localities and in great abundance, while other species are represented by one colony each. From the large number of specimens obtained, and the manner in which the colonies are crowded together on the foreign bodies to which they are attached, it may be inferred that the Ceylon seas are a favourable locality for the Polyzoa; but at the same time, from the multiplication of avicularia and of spinous processes of various sorts which characterise these Ceylonese specimens, the impression is derived that there is severe competition and that the colonies have a struggle to hold their own. It is possible that the avicularia, spines and other roughnesses on the surface of the zoarium may protect such species from being smothered by overgrowths of colonies of their own kind; and this seems a very necessary protection in this case, and the need may account for some of the extraordinary calcareous outgrowths of the zoœcia which I have to describe below.

Comparatively few collections of Polyzoa have been made in Indian seas. HINCKS (**16**) reported in 1887 upon a collection made by Dr. ANDERSON in the Mergui Archipelago. KIRKPATRICK (**22**) described in 1895 a collection made by Mr. THURSTON in the Gulf of Manaar. Among HINCKS's series of papers, entitled "Contributions towards a History of the Marine Polyzoa," in the 'Annals and Magazine of Natural History' (**8**), there is a report upon a small collection from Indian seas, and here and there among other papers of this series may be found descriptions of a specimen or two from Ceylon. In all, perhaps, 45 species have been previously described from the seas around Ceylon. Of these, 31 are represented in the present collection; and 85 additional species, including 16 new to science, are now recorded for the first time.

The work has been carried out chiefly in Liverpool, but it is a pleasure to record the help that has been freely given to me in Cambridge and in London. Dr. S. F. HARMER has kindly allowed me to consult his private collections of specimens and notes, and Mr. R. KIRKPATRICK has helped me with those at the British Museum; to both gentlemen I am indebted for advice and suggestions. In conclusion, I should like to express my gratitude to Professor HERDMAN for the privilege of being allowed to handle and name his valuable collection of Polyzoa.

ORDER: ECTOPROCTA.

SUB-ORDER: CHEILOSTOMATA.

FAMILY: ÆTEIDÆ.

Ætea anguina, LINN.

Localities:—Station I., off Negombo, 12 to 20 fathoms; and Station XLVI., off Mount Lavinia, 7 to 12 fathoms.

FAMILY: CATENARIIDÆ.

Catenaria lafontii (AUD.).

Locality:—North of Cheval Paar, 7 to 10 fathoms.

Catenicella elegans, Busk (1).

Locality : Gulf of Manaar (attached to floating oyster cages).

Family: CELLULARIIDÆ.

Scrupocellaria cervicornis, Busk (2).

Locality :—Navakaddu Paar, Gulf of Manaar.

Scrupocellaria diadema, Busk (2).

Localities :—North of Cheval Paar, in Gulf of Manaar, 7 to 10 fathoms; and Station LXIII., west of Periya Paar, 17 to 55 fathoms (large quantities).

Scrupocellaria scrupea, Busk (2).

Locality :—Gulf of Manaar.

Caberea retiformis (Pourtalès).

The peculiar, unequal development of the fornix, mentioned by Miss Phillips (25), is a characteristic of these Ceylon specimens. The upper half is developed into a long, sharp process, while the lower is scarcely produced below the stem by which it is attached to the zoœcium. Avicularia are present both along the median line and on the oœcia.

Locality :—Off Galle in deep water.

Family: BICELLARIIDÆ.

Diplœcium simplex, Kirkpatrick (20).

Localities :—North of Cheval Paar, 7 to 10 fathoms; off Manaar; and off Galle.

Bugula neritina, Linn.

There is one specimen in the present collection which differs from the others, being lighter in colour, less rigid in growth, and with avicularia. Hincks (12) mentions these last as present on some of his specimens, therefore there does not seem sufficient reason for separating the two forms. The avicularia are large, placed on the outer sides of the zoœcia, and have long mandibles. Oœcia are present in the position usual for the species.

Localities :—Palk Bay; and Gulf of Manaar.

Beania mirabilis, Johnston.

Locality :—Cheval Paar.

Family: CELLARIIDÆ.

Cellaria johnsoni, Busk.

Localities :—Gulf of Manaar; off Galle, deep water; and Station XL., 10 miles off Watering Point, 34 fathoms.

Nellia oculata, Busk (2).

Locality :—Gulf of Manaar.

Family : TUBUCELLARIIDÆ.

Tubucellaria cereoides (Ellis and Sol.).

Localities :—Off Galle and onwards up the West Coast of Ceylon, deep water; Navakaddu Paar, Gulf of Manaar (several colonies).

Family : MEMBRANIPORIDÆ.

Membranipora favus, Hincks (8).

There are tubercles between some of the zoœcia in the colonies of this species which otherwise agree with Hincks's description of the species.

Locality :—Gulf of Manaar (on *Conus* shells).

Membranipora irregularis, D'Orbigny.

Locality :—Gulf of Manaar.

Membranipora hastilis, Kirkpatrick (21).

Locality :—Gulf of Manaar.

Amphiblestrum cervicorne, Busk (2).

Locality :—Off Manaar Island (several colonies).

Amphiblestrum papillatum, Busk (1).

Localities :—Station XLVI., off Mount Lavinia, 25 to 30 fathoms; Navakaddu Paar, Gulf of Manaar.

Amphiblestrum granuliferum (Hincks, 3).

Localities :—Gulf of Manaar; off Galle; and off Mount Lavinia (several colonies).

Amphiblestrum marginella (Hincks, 8).

The lateral avicularia of these specimens are more pointed than in Hincks's description, and are directed upwards instead of downwards. The large avicularia occupying a whole zoœcial area are present.

Locality :—Gulf of Manaar.

Amphiblestrum delicatulum (Busk).

The Ceylon specimens show the serrated denticle of this form and have no avicularia. The zoœcia are not quadrangular but of a diamond shape, resembling *one* of the zoœcia in Hincks's figure (3, plate xi.) of this species. There are no knobs such as Hincks describes on his specimens. Oœcia are present, not described before; they are sunk

below the membrane of the zoœcium, above the one to which they belong, are finely punctured and have a calcareous arch above the zoœcial orifice. The colony is of a brownish colour and adheres closely to the bivalve shell on which it is growing.

Locality :—Gulf of Manaar.

Siphonoporella bursaria (MacGillivray, **23**).

The Ceylon colonies of this species have avicularia with spatulate mandibles, interspersed here and there among the zoœcia, on separate areas. In old specimens the front wall of the zoœcium is distinctly punctured. With these slight differences the specimens have all the appearance of *Membranipora rossellii* (Aud.) which MacGillivray (**23**, plate xxvi., fig. 4) later named *Amphiblestrum bursarium*. There is even an indication, in his drawing of one of the zoœcia, of a siphon, which is clearly present in the Ceylon specimens. I believe the specimens undoubtedly belong to MacGillivray's species.

Localities :—Off Galle; off Trincomalee; and from the Gulf of Manaar (several good colonies).

Family : ONYCHOCELLIDÆ.

Onychocella antiqua (Busk).

Locality :—East Cheval Paar, Gulf of Manaar.

Onychocella abyssicola (Smitt, **26**).

Localities :—Gulf of Manaar; and off Galle at Station XL., 10 miles off Watering Point, 34 fathoms.

Onychocella cucullata, n. sp.—Plate, fig. 1.

Zoarium incrusting or erect, branching and bilaminar. Zoœcia large and irregularly oval, raised towards the upper end, where the margin is often coarsely beaded. Operculum large and horse-shoe shaped, bent forward along with the raised portion of the zoœcium. Cryptocyst coarsely granular and punctured on the front wall, descending as in *Steganoporella lateralis*, MacGillivray (**24**), to the basal wall of the zoœcium and pierced by a tubular orifice which has an everted rim. Avicularia curved over the top of the zoœcium, usually branched on one side and having the tips of the branches more or less forked. A triangular swollen area, probably oœcial, is seen above some zoœcia, having an oval opening covered by a membranous operculum, situated in the centre of the beaded upper margin of the zoœcium to which it belongs.

Localities :—Gulf of Manaar; and off Trincomalee.

This species appears to be closely allied to *Steganoporella* in the form of zoœcium, but has a smaller operculum and avicularia of the *Onychocella* type. The two forms present in this collection, incrusting and erect, have the same zoœcial and avicularian characters, and cannot therefore be separated. The erect form is represented by

broken specimens of about 2 centims. in height, flat and branched in various ways and of a grey colour. The incrusting form has all the appearance of a *Steganoporella* to the naked eye.

FAMILY: MICROPORIDÆ.

Steganoporella buskii, HARMER (17).

There is a large colony of this species measuring about 10 square centims. It is growing in a loose honeycomb-like form and is of a remarkably light and brittle texture. Another colony, the same in detail, is incrusting a seaweed and is much smaller in every way.

Locality :—Cheval Paar, Gulf of Manaar.

Steganoporella sulcata, HARMER (17).

Locality :—Gulf of Manaar.

Steganoporella simplex, HARMER (17).

Localities :—Gulf of Manaar ; and off Trincomalee.

Thalamoporella rozieri (AUD.), form **indica**, HINCKS (3).

Localities :—Gulf of Manaar ; Palk Bay ; and off Galle.

Thalamoporella rozieri (AUD.), form **falcifera**, HINCKS (3).

Locality :—Generally distributed round the Ceylon coast.

FAMILY: CRIBRILINIDÆ.

Cribrilina radiata, MOLL.

Localities :—Off Galle ; Gulf of Manaar ; off Mount Lavinia ; and Station XL., 10 miles off Watering Point, 34 fathoms.

FAMILY: MICROPORELLIDÆ.

Microporella violacea, JOHNSTON, form **plagiopora**, BUSK.

Locality :—Gulf of Manaar.

Microporella ciliata (PALLAS).

Locality :—North of Cheval Paar, 7 to 10 fathoms.

Microporella ciliata, var. **personata**, BUSK (2).

The avicularia on the Ceylon specimens have wing-like membranous extensions of the sides of the mandible. Two of the colonies are of a pink colour.

Localities :—Gulf of Manaar ; and Station XXXIII., south-east of Ceylon, 18 fathoms.

Microporella decorata, Reuss.

Locality :—Gulf of Manaar.

Berenicea prominens, Lx. [= **Chorizopora brongniartii** (Aud.)].

Localities :—Gulf of Manaar ; off Galle, deep water ; and Station XL., off Watering Point, 34 fathoms.

Family : PORINIDÆ.

Porina magnirostris (MacGillivray, 23).

Locality :—Gulf of Manaar.

Gigantopora fenestrata, Ridley.

On the most perfect of the few, small, incrusting colonies of this form there are little branched spines, in between the perforations of the front wall of the zoœcia. The secondary, tubular orifice has a 4-toothed margin and avicularia are very long, reaching from the base of the tube and extending beyond its margin. Where an avicularium is absent the tube has a fissure in its place. Oœcia are present, low down at the back of the tubular orifice, and perforated like the front wall of the zoœcia.

Localities :—Gulf of Manaar ; and off Galle.

Lagenipora spinulosa, Hincks (8).

Locality :—Gulf of Manaar.

Lagenipora tuberculata, MacGillivray (23).

There are several colonies corresponding to MacGillivray's description of this species, but there are also among them some that have the hollow tubercles very much lengthened, ending in points, or being jagged and irregular in outline. These specimens have also simple or branched spines round the margin of the much raised peristome. The front walls of the zoœcia have punctures in between the spines ; the peristome is granular. There are no avicularia, and no oœcia are present.

Locality :—Off Galle.

Family : MONOPORELLIDÆ.

Monoporella albicans, Hincks (6).

An interesting point in the present example of this form is that the oœcia are in most cases set a little "awry," a fact that Hincks thought merely a peculiarity of the colony in his collection. There are none of the large avicularia present here.

Locality :—Gulf of Manaar.

Monoporella lepida, Hincks (5).

Locality :—Station LIII., north of Cheval Paar, 7 to 10 fathoms.

Family : MYRIOZOIDÆ, Smitt.

Schizoporella spongitis (Pallas).

Localities :—Gulf of Manaar ; and off Mount Lavinia.

Schizoporella ampla, Kirkpatrick (20).

Localities :—Gulf of Manaar ; and Navakaddu Paar.

Schizoporella argentea, Hincks (6).

In the single small colony of this species the sinus is wider than Hincks describes and there are no oval avicularia, but in their place the elongated kind as in some of his specimens. There are the two spines above and the granular, silvery surface of the zoœcia with foramina between the granulations.

Locality :—Gulf of Manaar.

Schizoporella aperta, Hincks (6).

There are two spines on the upper margin of some of the orifices of these specimens not described before. No oœcia are present, but in other points the characters agree with those of the species.

Localities :—Gulf of Manaar ; and Navakaddu Paar.

Schizoporella cecilia (Aud.).

The one small colony of this species has raised, irregular-shaped ridges of calcareous matter on the oœcium, and a decided arch above the orifice at the base of the oœcium, also a screen-like process on the front of the zoœcium.

Locality :—Gulf of Manaar.

Schizoporella unicornis, Johnston.

The present specimen has the peculiar long avicularia of the form *longirostris*, Hincks (11), but not the more important feature of that variety, namely the loop-shaped sinus.

Locality :—Navakaddu Paar.

Schizoporella nivea, Busk (1).

There are numerous colonies of this species, loosely attached, being, as it were, folded round the stems of the large zoophyte, *Campanularia juncea*, and having the opposed edges of the zoarium adhering to one another. (See Part II., p. 115, fig. 2.)

Locality :—Gulf of Manaar.

Schizoporella circinata, MacGillivray (23).

The zoœcia of these specimens have the ridge-like mucro of Hincks's (10) species, but not the avicularium. There is a single row of large punctures at the edge of the zoœcium. No oœcia are present on the two small colonies in the Ceylon collection.

Localities :—Off Mount Lavinia ; and off Galle.

Schizoporella sanguinea (Norman).

Avicularia are usually present on these specimens. They are long and pointed and raised, a pair on each zoœcium, situated at their extreme upper angles, above the orifice and directed downwards and inwards.

Locality :—Off Galle.

Schizoporella magnifica, Hincks (11).

The peculiar distinctive oœcia of this species are not present on the one colony in this collection, which is deep red in colour. The long pointed sinus, the pairs of upward pointing avicularia, and the reticulate front wall of the zoœcium, without a raised margin, accord with Hincks's description of the spécies.

Locality :—Off Galle.

Schizoporella depressa, Phillips (25).

There are some colonies of a pink colour corresponding with the figure and description of this species. The orifice of the zoœcium is deeply sunk, the front wall rising into almost an umbo below it, and calcareous ridges radiate from this to the margin, leaving large, loop-shaped areolations between them. The small rounded avicularia, on one or both sides of the orifice, are sunk below the surface, together with the orifice. Oœcia are smooth and hyaline or ridged, and have an oval area on either side of them.

Localities :—Gulf of Manaar ; and off Mount Lavinia.

Schizoporella triangula, Hincks (5).

The specimens of this form in the present collection have the triangular orifice, the raised margins and punctured surface of the zoœcium, with small avicularium pointing downwards from just below the orifice, although this last is smaller and never raised on an elevation. There is a second avicularium lying transversely on a separate area above the orifice. Busk (1) mentions, but does not figure, a second avicularium with a slender, spear-shaped mandible which corresponds with these, with the exception that his are described as lying vertically and these are transversely placed. Where oœcia are present, they take the place of these. They are large, covering nearly the whole of the zoœcium above the one to which they belong, as described by Busk, but are sub-immersed and have no nodules, being punctured like the zoœcium.

Localities :—Gulf of Manaar ; and East Cheval Paar.

Schizoporella subsinuata (Hincks, 9).

There are a few colonies of a grey-white colour, incrusting pieces of broken shell, having the zoœcial characters of this form with the addition of numerous avicularia, which in Hincks's specimens did not exist and which were rare in MacGillivray's (23). They have long, pointed mandibles, and are usually pointing downwards, like those in

MacGillivray's figure (plate cxxxviii., fig. 5), from an upper angle of the zoœcium; but are sometimes below the orifice, transversely placed, or they may be on separate, raised areas.

Localities:—Gulf of Manaar; and Navakaddu Paar.

Schizoporella avicularis, n. sp.—Plate, fig. 2.

Zoarium adnate, of a pink colour; zoœcium punctured, with slightly raised margins. Orifice with a broad sinus and umbo below it. Avicularia here and there large and spatulate, starting from above the umbo, covering over the oral aperture and resting on an extended portion of the zoœcium above. Oœcia large, more finely punctured than the zoœcium and with a calcareous arch over its summit.

Locality:—Gulf of Manaar.

I do not know of any species having an avicularium in the position described above. When the mandible is removed, the zoœcial orifice, with its operculum, appears beneath, in its usual form. There is a specimen, in this collection too, of *S. triangula*, which has apparently a similar arrangement of the avicularium and zoœcial orifice, but it will be necessary to examine more material before coming to a definite conclusion as to the exact relations of these parts.

Schizoporella collaris, n. sp.—Plate, fig. 4.

Zoarium incrusting, of a dull white colour. Zoœcia rhomboidal, punctured, the upper portion slightly narrowed to a neck and bent forward. Orifice with a broad shallow sinus, peristome thickened and forming a triangular bracket-like process in front. Oœcia punctured like the zoœcia, the sides extending to form with the peristome a collar round the orifice.

Locality:—Station XLVI., off Mount Lavinia.

Schizoporella pulcherrima (MacGillivray, 23).

There is a strong resemblance between the "small colony," described by MacGillivray, of this species and the large specimens from Ceylon, although the former has no punctures on the zoœcium, nor is it coloured, while the latter have punctures as well as radiating lines and are coloured a deep red, excepting for one colony, probably old, which is white. The raised margins of the broad zoœcia, the shallow sinus and avicularia on either side of the orifice are the same; these are sometimes quite up to the edge and in an angle of the zoœcium. Oœcia, not described before, are large, covering almost entirely the zoœcium above and embedded in it, punctured like the zoœcium. The orifices of the zoœcia which bear oœcia are larger than those of the others. It is a very striking species.

Localities:—East Cheval Paar; off Galle; off Mount Lavinia.

Schizoporella viridis, n. sp.—Plate, fig. 3.

Zoarium incrusting and forming very large colonies, extending to nearly two feet (50 centims. or upwards) across.

It has a coarse looking, roughened surface and is of a greenish colour, somewhat obscured by a brownish surface layer or membrane; zoœcium prostrate, irregularly oval, ventricose and punctured closely all over the front wall; often with an umbo in its centre, or to one side, which may become tall and massive. Orifice with a deeply rounded sinus, peristome raised above.

Avicularia small and pointed, one or two transversely placed below the orifice, and a few long and sword-shaped, on separate areas, scattered over the zoarium.

Locality :—Coral banks, Gulf of Manaar.

This fine species forms thick massive colonies of many superimposed layers, and spreads over other objects to form very large masses; one colony measures upwards of 53 centims. in length by 18 centims. in breadth and 23 millims. in thickness. The verdigris-green colour is a striking feature, best seen in the thickness of the superimposed layers at the edges of broken pieces; a brown membrane which envelops the zoarium conceals it, somewhat, on the surface. The large ventricose zoœcia and oœcia can be seen by the naked eye as small pimples covering the irregularly undulating surface of the zoarium. The zoœcia are always prostrate, but are heaped and turned in various ways and are seen at various levels.

Schizoporella incrassata, HINCKS (6).

The great variety in appearance of the zoœcia in different parts of one colony is quite as marked in the present specimens as it was in HINCKS'S, and, although the variations do not always agree with his, the differences seem to belong to unimportant characters. The primary orifice has, here, sometimes from 2 to 4 spines on its upper margin. A large process, bearing an avicularium, is sometimes to be seen on both sides of the orifice instead of on one side only. The surface of the zoœcium is usually grooved, the grooves radiating towards the centre. Avicularia on raised processes are scattered irregularly over the zoœcia. The peristome forms sometimes a spinous collar, open in front, or the points of the edges of the opening join and leave the opening below like an oval pore. The oœcium agrees with that of HINCKS'S species, but that the flat plate covering its aperture is of a dead white, contrasting with the glassy appearance of the rest of the zoarium.

Localities :—Gulf of Manaar; Station XL., 10 miles off Galle, 34 fathoms.

Mastigophora dutertrei, var. **pes-anseris** (SMITT, 26).

Locality :—Station XL., 10 miles off Galle, 34 fathoms.

Rhyncopora bispinosa, JOHNSTON.

The primary orifice of this species varies in one specimen from the usual shallow sinus form to one with a deeper, narrower sinus, which variety has also a crenulated margin as in *Rhyncopora crenulata*, WATERS (27), a species which has, however, no sinus.

Localities :—Gulf of Manaar; and Station XLVI., off Mount Lavinia.

Rhyncopora corrugata, n. sp.—Plate, fig. 5.

Zoarium incrusting, yellow-white in colour. Zoœcia large, distinct throughout, with the secondary orifice prolonged into a tube, widening from the base up and with an uneven margin. An uncinate process at the base of the tube a little to one side of the centre, and an avicularium of small size on the corresponding other side, its beak pointed and forming with the uncinate process a loop-shaped sinus.

Locality :—Gulf of Manaar.

The raised secondary orifice of this species gives it the appearance of a *Lagenipora*, but that the tube is irregularly fluted in outline. It is a good deal smaller than *Rhyncopora incisor*, n. sp., although at first taken to be the same when the two were growing together.

Rhyncopora incisor, n. sp.—Plate, fig. 6.

Zoarium incrusting, of a white colour. Zoœcia crowded, hexagonal, with a deeply areolated margin, a long tubular peristome and even rim.

Primary orifice orbicular with a transversely placed avicularium a little to one side of the centre, an uncinate process on the opposite side becoming very long and pointed. Oœcia behind the tubular orifice, smooth with a circular area on either side.

Localities :—Gulf of Manaar; and off Galle, 34 fathoms.

The characters of this species are very simple and constant; the most striking feature is the elongated uncinate process which sometimes projects almost across the orifice, so as to bar the entrance to the tube, and has a curved needle-like point. There is no avicularium to be seen when this stage is reached.

One perfectly preserved colony has the appearance to the naked eye of the pile of white velvet; the zoœcia almost approach those of *Lagenipora tuberculata* in size and appearance.

Hippothoa flagellum, Manzoni.

Locality :—Chilaw Paar.

Gemellipora glabra, form **striatula**, Smitt (**26**).

Localities :—Gulf of Manaar; Trincomalee; and off Mount Lavinia.

Gemellipora lata (Smitt, **26**).

The Ceylon specimens of this form have the yellow colour of the colony, the dark colour of the opercula, more brown than green in these specimens, the conspicuous pores of the zoœcia, the form of orifice and peculiar fold of the peristome below this, as figured by Smitt (**26**, plate vii., fig. 157).

Avicularia are distributed among the zoœcia, on separate areas, but are much larger than he describes and spatulate, not oval.

Oœcia, not described before, are more broad than high, perforated like the zoœcia,

with, sometimes, an umbo. The orifices of fertile zoœcia are much larger than those of the others.

Locality :—Gulf of Manaar.

Gemellipora protrusa, n. sp.—Plate, fig. 7.

Zoarium incrusting, of a pale brown colour. Zoœcia rhomboidal, smooth or slightly roughened, front wall much raised, punctured round the margin. Orifice of the usual *Gemellipora* form, sometimes much elongated; peristome often raised above and irregularly lobed. A large avicularium on the front of the zoœcium, directed across it, supported on a raised process; mandible wide at the base, becoming long and pointed; a small avicularium, with rounded mandible, on a raised process on one or both sides of the orifice. Oœcia granular and minutely punctured, open in front, and leaning forward over the orifice.

Locality :—Gulf of Manaar (numerous colonies on Nullipore balls).

There are sometimes two avicularia, in place of the one large transversely placed one; they point outwards to either side of the zoœcium. There is some resemblance in the appearance of this species to *Schizoporella ampla*, KIRKPATRICK (20).

FAMILY: ESCHARIDÆ.

Lepralia robusta, HINCKS (8).

The central circular pore, alluded to by HINCKS, is quite evident on the present specimens, and is sometimes multiplied to three or more of irregular shapes, as seen in an old, worn specimen.

Locality :—Gulf of Manaar (in large quantity on broken shells).

Lepralia poissonii, AUDOUIN.

Localities :—Navakaddu Paar; off Galle and onwards up West Coast, deep water.

Lepralia mortoni, HASWELL (19).

Localities :—Gulf of Manaar; off Trincomalee; north end of East Cheval Paar.

Lepralia triangula, n. sp.—Plate, fig. 8.

Zoarium incrusting. Zoœcia punctured all over, covered by a yellow membrane. There are usually scattered spinous processes on the front wall of the zoœcium and also two curved horn-like processes, one on either side below the orifice, which may be avicularia. Orifice longer than broad, with a much raised, thin, often irregularly pointed peristome, forming a collar round it. Operculum with a triangular excrescence having its base attached to the base of the operculum. No oœcia.

Locality :—Gulf of Manaar.

It is possible this species may be a variety of *L. pallasiana*, MOLL., as it resembles *L. cantheriformis*, BUSK, which is probably a variety of *L. pallasiana*, but the

peculiar processes on the cell wall and that on the operculum give it a distinctive character.

Lepralia turrita, Smitt (26).

The fresher looking colonies of this species are pink in colour and have pointed tubercles round the margin of the orifice; with age they become white and the tubercles worn down into blunt knobs. There are large spatulate avicularia on the sides of large massive tubercles and small oval ones on more slender tubercles, and also scattered over the zoœcia.

There are very few oœcia, and I have not been able to see perforations on them. They have a semicircular, marked area in front.

Localities:—Gulf of Manaar; Station XL., 10 miles off Galle, 34 fathoms; Navakaddu Paar.

Lepralia multidentata, n. sp.—Plate, fig. 9.

Zoarium incrusting, white. Zoœcia very small, rotund, irregularly placed, usually lying flat, but occasionally standing upright, surface roughened. Orifice arched above, sides widening downwards, base slightly convex, six long slender spines on the upper margin and a long, pointed rostrum below. Sometimes avicularia with rounded mandibles are present on either side of the orifice. Oœcia granular above, smooth in front, with an arched rib between the rough and the smooth portions.

Localities:—Gulf of Manaar; and off Trincomalee.

Lepralia cucullata, Busk (2).

Localities:—Cheval Paar, Navakaddu Paar and elsewhere in Gulf of Manaar (common on Ascidians and pearl oyster shells).

Lepralia depressa, Busk (2).

Avicularia in various forms, long and seta-like, or thick and spear-like, or the mandible branched, looking like the leg and foot of a bird.

Localities:—Gulf of Manaar and off Galle.

Lepralia gigas, Hincks (10).

Localities:—Station LIII., north of Cheval Paar, 7 to 10 fathoms; Palk Bay; Trincomalee (many large colonies, up to 3 inches across); Welligam Bay; and various parts of Gulf of Manaar (growing on pearl oyster shells).

Lepralia purpurea, n. sp.—Plate, fig. 13.

Zoarium forming purplish grey patches, incrusting. Zoœcia small with thick walls, sub-immersed, diamond-shaped, occasionally heaped and upright, smooth and shining or slightly roughened. Orifice arched above, widening downwards, with an almost straight lower lip, peristome slightly thickened with five marginal spines and a sub-

oral mucro below the orifice. The tip of this, the bases of the spines and the peristome are of a purple tint. Sometimes an avicularium on a raised process at one side of the zoœcium, varying in size, spatulate and large or small and pointed. Oœcia small, narrow, open in front, two of the spines showing in front.

Locality :—Gulf of Manaar.

Lepralia nitida, n. sp.—Plate, fig. 10.

Zoarium closely adhering, with a shining surface, pale yellow in colour. Zoœcia flat but rising to a prominent umbo situated below the orifice, granular, the granules radiating from the umbo to the margin of the zoœcium which is punctured there. Orifice arched above, narrowing, then widening, and with a convex lower lip. A small round avicularium on either side on a level with the lower margin of the orifice. Oœcia small, rising to a prominent umbo, orifice of the fertile zoœcium much larger than the usual orifice.

Locality :—Gulf of Manaar.

This is a small neat species with little variation of form. The oœcia are merely like a triangular extension of the zoœcium above the orifice.

Lepralia adpressa, Busk (2).

The surface of the zoœcium in the present specimen is granular, punctured round the margins only ; the upper portion of the zoœcium is considerably raised ; the lateral lumps carry small round avicularia; when in old specimens these are absent the lateral processes are seen to be hollow tubes. Sometimes two or three of these processes are present above the orifice and one below in addition.

Locality :—Off Galle, deep water.

Lepralia feegeensis, Busk (2).

The oœcium of this species has not been described before. There is one well preserved oœcium on the Ceylon specimen. It is large and irregular in shape, the front wall is marked with large circular pitted areas, punctured in their centres, giving the oœcia a much coarser appearance than the zoœcia, the reverse of what is seen in *Lepralia gigas*, Hincks (10). The orifices of fertile zoœcia are broader at their bases than those of others. Avicularia of the usual type, and in the usual position for *L. feegeensis*, are often present in pairs, but usually singly, or there may be none.

Locality :—Gulf of Manaar.

Lepralia cleidostoma, Smitt (26).

There is one small colony of this species. It has no oœcia to show the characteristic striæ as a help to identification, and the avicularia are always directed upwards, not outwards. On one of the zoœcia, on the outside of the colony, jointed spines are to be seen, as in Smitt's (26), plate xi., fig. 217. A larger, loosely incrusting colony from

another locality resembles this so nearly as to make it probable it is one of the same species. The zoœcia are larger, avicularia are smaller and turned sideways, as in Smitt's figures. Oœcia are present here, but are punctured, not striated, and they are often half buried in the calcification of the zoarium. There is still a third variety, smaller than either of the above, and with a smooth and glistening surface, with avicularia turned sideways and oœcia faintly striated, but with a small arched area in front. As all these three specimens have the same key-shaped orifice and pointed avicularia I am inclined to think them varieties of the one species.

Localities :—Gulf of Manaar ; and off Galle.

Lepralia ceylonica, n. sp.—Plate, fig. 11.

Zoarium adhering, of a yellowish-white colour. Zoœcia in linear series closely set, becoming upright in places, with glistening front walls, pitted and punctured and lumpy. Orifice arched above, with straight sides and slightly concave lower lip, six long sharp spines above and several bosses below the orifice, carrying small avicularia with pointed mandibles on their summits. Oœcia roughened like the zoœcia and having scattered raised avicularia upon them.

Locality :—Gulf of Manaar.

Lepralia fissa, n. sp.—Plate, fig. 12.

Zoarium incrusting, forming brown patches. Zoœcia finely punctured at the outside of the colony, becoming coarsely ridged further in and having a large umbo occupying most of the area, and a large avicularium on its outer side, with the mandible directed upwards. Orifice broader than long, with a pouting lower lip. Oœcia rounded, smooth, with a large cone-shaped fissure in front.

Locality :—Off Galle, deep water.

Lepralia subimmersa, MacGillivray (23).

There is one colony, greyish-white in colour, and covering the shell of a univalve mollusc inhabited by a hermit crab. Another colony is of a deep red colour, from a membranous covering still adhering to the zoarium.

Locality :—Gulf of Manaar.

Escharoides verruculata (Smitt, 26).

Localities :—Gulf of Manaar ; and off Mount Lavinia.

Porella malleolus, Hincks (8).

Localities :—Gulf of Manaar ; off Galle ; Navakaddu Paar.

Smittia trispinosa (Johnston).

There is great variety in the form of zoœcia and avicularia among the Ceylon

specimens of this species. It is widely distributed around the coast, and apparently very abundant.

Localities :—Gulf of Manaar ; off Galle ; off Mount Lavinia ; and Navakaddu Paar.

Smittia trispinosa, var. spatulata (Smitt, 26).

Locality :—Station XLVI., off Mount Lavinia.

Smittia trispinosa, var. protecta, nov.

This large variety has the peristome raised and in front, below the orifice, produced into a long spout-like extension. Avicularia, not on every zoœcium, are of enormous size, reaching from above the orifice and bending and spreading so as to cover the whole front wall of the zoœcium, and having a blunt extremity.

There are sometimes two small raised avicularia, one on either side of the orifice. The finely punctured oœcium has a narrow, prominent arched rib across the front.

Locality :—Gulf of Manaar.

Smittia tubula, Kirkpatrick (20).

The present specimens of this form are of a pink colour. There are usually two avicularia, one on either side of the tubular secondary orifice, pointing upwards. Two of the oral spines, of which there are six, remain in front of the oœcium when present.

Locality :—Gulf of Manaar.

Smittia rostriformis, Kirkpatrick (20).

Avicularia on these specimens are sometimes pointing downwards, as figured by Kirkpatrick, but sometimes upwards with the appearance of a spine on either side of the orifice. In both cases the peculiar serrated edge of the beak is plainly visible. Oral spines vary in number from two to six. In other respects the specimens agree with the original description of the species.

Locality :—Station XLVI., off Mount Lavinia.

Phylactella spiralis, n. sp.—Plate, fig. 14.

Zoarium forming small pink patches on shells. Zoœcia arranged in radiating lines, smooth or slightly roughened, areolated round the margin, with a much raised tubular peristome and an avicularium raised to the margin of this on a semi-spiral tube. Primary orifice, having a very wide denticle with sharp lateral points. Secondary orifice, with from two to four spines above. Oœcium behind the tubular peristome, smooth or slightly roughened like the zoœcium.

Localities :—Gulf of Manaar ; off Mount Lavinia ; and off Galle.

This species approaches most nearly to *Phylactella geometrica*, Kirkpatrick (21), in form, but the one broad denticle instead of three and the difference in the position of the avicularium, which resembles that of *Lagenipora nitens* (MacGillivray, 23), makes it impossible to mistake the two species.

Mucronella coccinea, ABILD.

Localities :—Gulf of Manaar ; and off Galle.

Mucronella tubulosa, HINCKS (3).

In the Ceylon specimens, which I believe to belong to this species, there is an enormous development of the central mucro, which is here long and spinous ; there is also an avicularium on the inner side of this, either at its base, lying in front of the primary orifice, or at varying heights up this process, always transversely placed and with a sharp curved beak, but varying in size.

These points add to the resemblance between *M. tubulosa* and *Rhyncopora longispinosa*, which Miss JELLY regards as synonymous, but there is missing still, in these specimens, the uncinate process of *Rhyncopora*, unless the curved beak of the avicularium takes the place of this. In the faint indication of a sinus of the primary orifice, the spinous mucro and markings of the oœcia, there is a likeness to a species of quite another genus, *i.e.*, *Cellepora longirostris*, MACGILLIVRAY, as described by Miss PHILIPPS (25).

Localities :—Off Trincomalee ; off Mount Lavinia ; Navakaddu Paar and elsewhere in the Gulf of Manaar.

Mucronella thenardii, AUD.—Plate, fig. 15.

The cross-shaped process, situated below the orifice of the zoœcium in this species, is greatly developed (see fig. 15). Its upright portion is often occupied by a large spatulate avicularium, and, where this is so, one of the arms of the cross is missing, giving a one-sided appearance to the process. Sometimes the arms are duplicated, one pair below the other, and they are always much branched, each branch bearing a small, rounded avicularium on its summit. Slender, spinous processes, resembling the branches in size, are scattered over the front wall and round the margin of the orifice of the zoœcium, and there are sometimes ordinary spines, from two to five in number.

There is a strong resemblance between the characters of this species and those of *M. aviculifera*, HINCKS (14). The slender, spinous, aviculiferous processes are present there, but the cross-shaped mucro is only represented by a small simple mucro, and there are large, lateral avicularia. There is, however, much variation in form and position of the avicularia and of the processes which carry them, even in one small specimen of the present collection, so that it seems possible that the differences represent various stages in the development of one and the same species.

Localities :—Gulf of Manaar ; and off Galle.

Mucronella vultur, HINCKS (7).

There are in the present collection specimens having all the important characteristics of *M. vultur*, as described by HINCKS (7) and MACGILLIVRAY (23) with this exception, that the avicularium on the central mucro has a rounded, instead of a

pointed, mandible. There are sometimes small, raised, rounded avicularia scattered over the front wall of the zoœcium in great profusion. Some of the specimens have spinous knobs in front of the oœcia and also one on the summit of this.

Altogether, with the addition of the usual six long marginal spines of the orifice, the colony has a formidable appearance, especially in specimens where the zoœcia are crowded together. The largest colony is partly incrusting and partly sends off free expansions. It measures 8 centims. by 4 centims. and is of a dull pale brown colour and of a very brittle and light substance.

Locality :—Gulf of Manaar (growing over a colony of *Lepralia gigas*, Hincks).

Retepora tubulata, Busk (1).

Locality :—Gulf of Manaar.

Retepora simplex, Busk (1).

Locality :—Off Galle and onwards up west coast of Ceylon.

Retepora apiculata, Busk (1).

Locality :—Ceylon seas.

Retepora pocillum, n. sp.—Plate, fig. 16.

These colonies correspond with *Retepora avicularis*, MacGillivray (23), in size, and the zoœcia in having triangular teeth within the orifice, and below this a loop-shaped fissure, but there are some other additional marked characteristics in these specimens. The zoœcia are rhomboidal in form and have slightly tubular necks crowned by about six spines, which are beautifully jointed in the Equisetum-like form described for *R. monilifera*, MacGillivray (23). These are often broken, but their bases, which, united, form the tubular neck, are visible, and when oœcia are present two are to be seen in front of it, not always of the jointed form. The oœcia have a fissure faintly visible. There is generally a small avicularium with a rounded mandible below the orifice, more or less in the middle of the zoœcium; sometimes there are two of these, one below the other, or rarely one large spear-shaped one, lying across the zoœcium and pointing upwards.

Locality :—Gulf of Manaar.

Family: ADEONIDÆ.

Adeonella subsulcata (Smitt, 26).

The largest colonies of this species in the present collection are about 8 centims. in height. They correspond entirely with Smitt's description, but that there is also a serrated denticle within the orifice, corresponding to that of *A. pectinata*, Busk (1).

Localities :—Station I., off Negombo, Gulf of Manaar; Station XXIX., Trincomalee; Station XLVI., off Mount Lavinia, 25 to 30 fathoms; Station XL., 10 miles off Watering Point, 34 fathoms; and off Galle, deep water.

Family: CELLEPORIDÆ.

Cellepora albirostris (Smitt, 26).

Localities:—Gulf of Manaar; off Mount Lavinia; off Kaltura; and off Galle, deep water. There are large quantities of this species.

Cellepora megasoma, MacGillivray (23).

There is usually a raised avicularium to one or both sides of the orifice on the present specimens and large scattered spatulate ones here and there. The zoœcia are smooth or slightly ridged. Oœcia thickly punctured all over, with no marked area.

Localities:—Off Galle and onwards up west coast of Ceylon, deep water; Gulf of Manaar (several colonies on worm tubes and stems of Zoophytes); Station XXXII., off south-east coast of Ceylon (on Sponge).

Cellepora rota, MacGillivray (23).

Localities:—Station LIII., north of Cheval Paar, 7 to 10 fathoms; and elsewhere in Gulf of Manaar.

Cellepora cidaris, MacGillivray (23).

There is a large quantity of material resembling the description of this form excepting that the columnar processes in between the zoœcia are solid instead of hollow. *C. albirostris*, Smitt, has, in the "Challenger" collection, occasional, solid columns of this sort on the older parts of a colony, but, although the two species *C. albirostris* and *C. cidaris* of the present collection resemble each other pretty closely in some points, neither the long pointed rostrum, nor the broad one with serrated beak, nor the dark operculum, characteristic of *C. albirostris*, are present on the specimens I have considered to be *C. cidaris*. Oœcia, said in *C. cidaris* to be globular and immersed, have an arched area in front, which, being often absent, leaves a cave-like space. There are occasional large spatulate avicularia to be found on raised areas in between the zoœcia, but these are the only points of difference to be seen between the present specimens and MacGillivray's description of *C. cidaris*.

Localities:—Off Mount Lavinia; Station XL., off Galle, 34 fathoms; and in Gulf of Manaar.

Cellepora compacta, n. sp.—Plate, fig. 17.

Zoarium incrusting, white or purplish in colour. Zoœcia small, upright, rounded, smooth, with a few marginal punctures.

Orifice rounded, with a loop-shaped sinus, and below, rather to one side, a large thick rostrum, sometimes pointed above, having a long pointed avicularium on its side; often other slenderer processes round the orifice and long hollow columns in between the zœcia. Oœcia standing upright, smooth and shining, with a narrow arched ridge in front.

Locality:—Gulf of Manaar.

SUB-ORDER: CYCLOSTOMATA.

FAMILY: CRISIIDÆ.

Crisia holdsworthii, BUSK (2).

Localities:—Station LIII., north of Cheval Paar, 7 to 10 fathoms; Station I., and elsewhere in Gulf of Manaar; and Palk Bay.

FAMILY: TUBULIPORIDÆ.

Idmonea milneana, D'ORB.

Localities:—Navakaddu Paar; and Station XL., 10 miles off Watering Point, 34 fathoms.

FAMILY: LICHENOPORIDÆ.

Lichenopora hispida, FLEMING.

Localities:—Navakaddu Paar, and elsewhere in Gulf of Manaar.

Lichenopora novæ-zelandiæ, BUSK (2).

Locality:—Navakaddu Paar.

SUB-ORDER III.: CTENOSTOMATA.

FAMILY: ALCYONIDIIDÆ.

Alcyonidium mytili, DALYELL.

Locality:—Gulf of Manaar.

Pherusa tubulosa, LX.

The largest colony among the few present in the present collection is about 3 centims. in height, and its branches spread to about the same in width. Zoœcia are on both sides of the branch, not as in the original description only on one surface.

Locality:—Station LIII., north of Cheval Paar, 7 to 10 fathoms.

FAMILY: ARACHNIDIIDÆ.

Arachnidium fibrosum, HINCKS (15).

Locality:—Gulf of Manaar.

Family: VESICULARIIDÆ.

Amathia distans, Busk (1).

Locality :—Gulf of Manaar.

Farrella atlantica, Busk (1).

Locality :—North of Cheval Paar.

Family: BUSKIIDÆ.

Buskia setigera, Hincks (16).

Localities :—Station LIII., north of Cheval Paar, 7 to 10 fathoms; and Palk Bay.

Family: CYLINDRŒCIIDÆ.

Cylindrœcium dilatatum, Hincks (15).

Localities :—Station LIII., north of Cheval Paar, 7 to 10 fathoms; off Galle; and Station I., off Negombo.

Family: VALKERIIDÆ.

Valkeria uva, Linn.

Locality :—Station LIII., north of Cheval Paar, 7 to 10 fathoms.

Order: ENTOPROCTA.

Family: PEDICELLINIDÆ.

Ascopodaria discreta, Busk (1).

One small colony of a reddish colour, growing on a sponge.
Locality :—Navakaddu Paar.

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(7.) ——— " " " " 5, " x.
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(9.) ——— " " " " 5, " xiv.
(10.) ——— " " " " 5, " xv.
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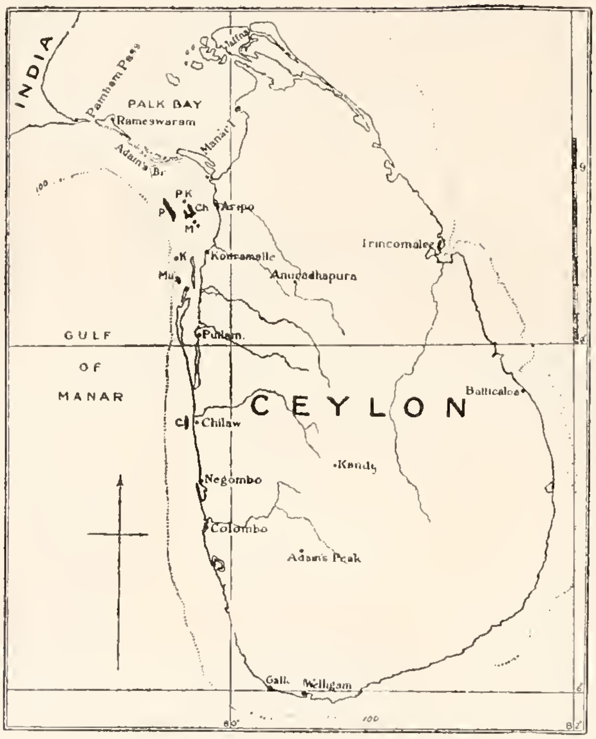
EXPLANATION OF PLATE.

1. *Onychocella cucullata*, n. sp.
2. *Schizoporella avicularis*, n. sp.
3. " *viridis*, n. sp.
4. " *collaris*, n. sp.
5. *Rhyncopora corrugata*, n. sp.
6. " *incisor*, n. sp.
7. *Gemellipora protrusa*, n. sp.
8. *Lepralia triangula*, n. sp.
9. " *multidentata*, n. sp.
10. *Lepralia nitida*, n. sp.
11. " *ceylonica*, n. sp.
12. " *fissa*, n. sp.
13. " *purpurea*, n. sp.
14. *Phylactella spiralis*, n. sp.
15. *Mucronella thenardii*, AUD.
16. *Retepora pocillum*, n. sp.
17. *Cellepora compacta*, n. sp.



Sketch-map of the Ceylon coast, showing the principal localities from which specimens were collected. C., Chilaw Paar; Ch., Cheval Paar; K., Karativo Paar; M., Modragam Paars; Mu., Muttuvaratu Paar; P., Periya Paar; P.K., Periya Paar Kerrai.

R T del.

E Wilson Cambridge

REPORT

ON THE

MEDUSÆ

(HYDROMEDUSÆ, SCYPHOMEDUSÆ AND CTENOPHORA)

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

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[WITH FOUR PLATES.]

INTRODUCTION.

THE collection of Medusæ brought back by Professor HERDMAN from Ceylon and another forwarded by Mr. JAMES HORNELL were kindly sent to me by Professor HERDMAN for examination. So far as I know there are no previous records relating to the medusæ of Ceylon, except for the Siphonophora which have been specially studied on the spot by HAECKEL. Unfortunately none of his beautiful species occur in the collection.

The specimens come chiefly from two places—Galle, at the south of Ceylon, and the Pearl Banks in the Gulf of Manaar. It is distinctly a littoral collection from shallow water, and the littoral character is shown by the number of Anthomedusæ and Leptomedusæ. The collection has not brought to light any new genera, nor are the species in any way very remarkable, considering that they live within a tropical region, in a sea at about 80° F. From a geographical point of view the collection is a valuable one, as it has increased our knowledge of the distribution of genera.

Some of the specimens had been splendidly preserved and were a pleasure to work with, but many were in bad condition, more or less broken up, and these gave me endless trouble. I have endeavoured, as far as possible, to give such details as I hope

will lead to the recognition of the species again, but should any doubt arise when comparing a description or figure with living specimens, I would suggest that it would be better to amend my work rather than describe another species.

[After this report had been sent to the printer I received intimation from Professor OTTO MAAS, of Munich, that he was preparing for publication his account of the Hydromedusæ of the Dutch "Siboga" Expedition. As our respective reports were likely to be published about the same time we agreed to exchange proofs. I wish here to express my thanks to Professor MAAS for his kindness in allowing me to make use of his work, which must be regarded as a valuable contribution towards our knowledge of the Hydromedusæ.

A few of the species in the Ceylon collection were also taken by the "Siboga" in the East Indies, namely:—*Irenopsis hexanemalis*, *Octocanna polynema*, *Mesonema pensile*, *Liriope tetraphylla*, and *Solmundella bitentaculata.*]

The following is a classified list of the species described in this report:—

HYDROMEDUSÆ.

ANTHOMEDUSÆ.

Dipurena sp.?
Cytæis herdmani, n. sp.
Proboscidactyla minima, n. sp.

LEPTOMEDUSÆ.

Laodice indica, n. sp.
Mitrocomium assimile, n. sp.
Eutima curva, n. sp.
Octorchis orientalis, n. sp.
Irene ceylonensis, n. sp.
Irene palkensis, n. sp.
Irenopsis hexanemalis, GOETTE.
Octocanna polynema (HAECKEL).
Æquorea conica, n. sp.
,, *parva*, n. sp.
Mesonema pensile (MODEER).

TRACHOMEDUSÆ.

Gonionemus hornelli, n. sp.
Olindias sp.?
Liriope tetraphylla (CHAM. ET EYS.).

NARCOMEDUSÆ.

Solmundella bitentaculata (QUOY ET GAIM.).

SIPHONOPHORA.

Diphyes chamissonis, HUXLEY.
Cupulita sp.?
Agalmopsis sp.?
Physalia utriculus, ESCH.
Porpita sp.?

SCYPHOMEDUSÆ.

Charybdea sp.?
Nausithoe punctata, KÖLL.
Pelagia sp.?
Crambessa sp.?

CTENOPHORA.

Pleurobrachia globosa, MOSER, var. *ceylonensis*, n.
Beroe flemingi (ESCH.).

A Comparison between the Medusæ of Ceylon and those of the Maldives.

It is somewhat hazardous to draw a comparison between the medusoid fauna of Ceylon and that of the Maldives. About that of Ceylon I feel that we at present know but little, in fact, we have just made a beginning in our observations. We know, perhaps, a little more about the medusæ of the Maldives, which have recently been visited by two expeditions—the first under the leadership of Mr. Stanley Gardiner, and the second, which soon followed the first, under the guidance of Professor Alexander Agassiz.

Leaving out the oceanic medusæ, which have usually a wide geographical range, and limiting the comparison to the Anthomedusæ and Leptomedusæ, Mr. Gardiner's collection contained 5 genera and 5 species (3 of which were new species). Professor Agassiz's collection contained 10 genera (1 new genus) and 11 species (6 of which were new species and 3 were not named). With the possible exception of one of the Æquoriidæ, the genera and species were quite distinct in the two collections. Taking the two collections, without any limitations, there is a well-marked difference between them, which is quite as great as if they had come from localities a thousand miles apart. It is difficult to assign a correct reason for such a difference, but probably a different season of the year and the localities visited had much to do with it.

The two Maldive collections contain altogether 14 genera and 15 species of Anthomedusæ and Leptomedusæ. The Ceylon collection contains 12 genera and 14 species (10 of which are regarded as new species). A comparison between the Maldive and Ceylon collections shows that 6 genera (*Dipurena?*, *Proboscidactyla*, *Irene*, *Irenopsis*, *Mesonema* and *Æquorea*) are common to both, but only 2 species (*Irenopsis hexanemalis* and *Mesonema pensile;* the former also occurs at Zanzibar and the latter in the Red Sea). I think that these figures show clearly that the medusoid fauna of Ceylon is quite distinct from that of the Maldives.

HYDROMEDUSÆ.

Order: ANTHOMEDUSÆ.

Family: SARSIIDÆ, Forbes, 1848.

Dipurena, McCrady, 1858.

Dipurena, sp. ?—Plate II., figs. 1 and 2.

Description.—Umbrella about as high as broad. Manubrium extending beyond the margin of the umbrella. Mouth circular. Gonads arranged in several large

isolated clusters upon the manubrium. Four tentacles with globular basal bulbs, and with numerous small clusters of nematocysts. Ocellus upon the outer side of each basal bulb.

Size :—Umbrella about 3 millims. in width and height.

Locality :—Galle Bay, one specimen on June 12 and two on August 25.

Notes.—The umbrella of the three specimens is so badly out of shape that a figure of it cannot be given. The manubrium (fig. 2) is a long thin tube, about two to three times the length of the cavity of the umbrella, with an apical knob in the jelly of the umbrella, and with a large terminal stomach which has a circular mouth. The gonads are situated on the manubrium in large roundish clusters, and their size makes them conspicuous. One specimen has four clusters of gonads, another has two clusters. The third specimen has lost its manubrium. The stomach itself also appears to be surrounded with generative cells. The tentacles (fig. 1) are long and flexible, and are closely studded with clusters of nematocysts, except for a short distance next to the basal bulb. The upper half of the basal bulb is globular and embedded in the jelly of the umbrella, the lower part is like a circular band round the tentacle, broader on the inner side than on the outer side. In this band, on the outer side, the ocellus is situated. The ocellus is circular, of a yellowish colour in formalin, and has a small lens.

I have placed this species in the genus *Dipurena* and follow at present HAECKEL'S classification, though I think that this species and *Dipurena ophiogaster* will ultimately have to be removed to another genus. All the other species have the nematocysts on the tentacles confined to a large conspicuous terminal knob, and some in addition have a few large swellings containing nematocysts just above the terminal knob. *Dipurena ophiogaster* has the nematocysts on the tentacles arranged in quite a different manner. They form numerous semi-circular or three-quarter spiral loops round the tentacle when it is in a contracted or semi-contracted state. When the tentacle is fully expanded the nematocysts form minute globular clusters which give a moniliform appearance to the tentacle. The terminal cluster of nematocysts is very small and inconspicuous. The arrangement of the nematocysts of this species from Ceylon is similar to that of *Dipurena ophiogaster* and to that found in the genus *Sarsia.*

The specimens from Ceylon are very much like *Dipurena ophiogaster* which belongs to the British fauna, and it is not possible to point out a character in the structure of the tentacles or the manubrium with its gonads by which they can be specifically separated. As the specimens are in bad condition, I think it is best to leave the specific name in abeyance. They may differ from the *Dipurena ophiogaster* in the shape of the umbrella, in colour, and perhaps in other details.

BIGELOW (1904) found at the Maldives a *Dipurena* which he was not able to clearly distinguish from *Dipurena fragilis*, MAYER, belonging to the fauna of the Tortugas in the West Indies.

Family: MARGELIIDÆ, Haeckel, 1877.

Cytæis, Eschscholtz, 1829.

Margeliidæ with four single perradial marginal tentacles, and with unbranched oral tentacles.

Cytæis herdmani, n. sp.—Plate I., fig. 1; Plate IV., fig. 12.

Description.—Umbrella somewhat bell-shaped, about as high as broad, with fairly thick walls. Velum narrow. Stomach large, about as long as wide, situated on a short peduncle, and extending a little over half-way down the cavity of the umbrella. Mouth circular (expanded) with about 50 to 60 oral tentacles, which are unbranched and evenly distributed. Four broad radial canals. Gonads forming four large perradial swellings, and extending the whole length of the stomach. Four thick tentacles, perradial, with very large basal bulbs, which are somewhat triangular in shape.

Size:—Umbrella about $3\frac{1}{2}$ millims. in width and height.

Locality:—One specimen from Chilaw Paar on March 20, and one from Cheval Paar on November 11.

Notes.—Of these two specimens, one is an adult and the other is an intermediate stage. The stomach is cross-shaped in transverse section, and the gonads occupy the sides of the cross. The oral tentacles have a small round terminal cluster of nematocysts. The four marginal tentacles are thick and have a dark central band of pigment (perhaps a brilliant colour in the sea). A transverse section (fig. 12) shows that the pigment granules are confined to the endoderm cells, which form a solid central band of cells along the tentacle. The pigment granules form a dense layer round the periphery of the endoderm, and are also scattered along the walls of the cells. There is a fairly thick layer of mesoglœa and an extra thick ectoderm which contains an enormous number of nematocysts, closely packed together. The basal bulbs are very large and extend some way up the umbrella. There is a layer of dark pigment along the inner side of the bulb, and a thick whitish mass of cells on the outer side. Sections were not cut of the basal bulb, but the dark pigment granules would probably denote the endoderm and the external whitish cells the ectoderm. The specimen at the intermediate stage in development is about 2 millims. in width and height. It has four marginal tentacles, fewer oral tentacles, and smaller gonads than the adults.

This species is nearly related to *Cytæis nigritina* and *Cytæis macrogaster* of Haeckel. It differs from them in having many more oral tentacles, in the shape of the basal bulbs, and in the structure of the tentacles.

Family: WILLIIDÆ, Forbes, 1848.

Proboscidactyla, Brandt, 1835, ex Browne, 1904.

Williidæ with four radial canals leaving the stomach.

Proboscidactyla minima, n. sp.—Plate II., fig. 3.

Description.—Umbrella fairly thin and probably hemispherical in shape. Stomach divided into four longitudinal lobes. Mouth with a sinuous margin. Four radial canals with lateral branches. Gonads upon the lobes of the stomach. Tentacles short, about 16 to 20, with globular basal bulbs.

Size :—Umbrella about 1 millim. in diameter.

Locality :—Marichchukaddi, on the Gulf of Manaar, in February.

Notes.—There are 12 specimens, but their condition does not permit the production of a figure. I was unable to trace out the branching of the radial canal system, owing to the umbrella of all the specimens being more or less contracted, and to their fragile condition. The stomach is divided longitudinally into four lateral lobes and appears cross-shaped in transverse section. The gonads form lateral swellings upon the sides of the lobes, which do not extend along the top of the umbrella. The tentacles (fig. 3) are very short, about 0·25 millim. in length, and have a globular basal bulb situated in the jelly of the umbrella. On the ex-umbrella, not far from the margin, there are circular clusters of nematocysts, one between every two tentacles. The velum is very narrow. A few of the specimens are about 0·75 millim. in diameter and have 10 to 12 tentacles. Others, a little older, have 14 to 16 tentacles. One specimen has 18 tentacles. A full-grown adult has probably 20 tentacles. This species may be distinguished by the smallness of its size and the position of the gonads on the stomach.

Order : LEPTOMEDUSÆ.

Family : THAUMANTIIDÆ, Gegenbaur, 1856.

Laodice, Lesson, 1843.

Laodice indica, n. sp.—Plate I., fig. 5; Plate IV., figs. 7 to 11.

Description.—Umbrella slightly curved, about two to four times as broad as high, with moderately thick walls. Stomach cross-shaped, fairly large. Mouth with four short lips, having a slightly folded margin. Gonads extending from the stomach to about half-way or close to the margin of the umbrella, forming a large hollow sac upon each of the four radial canals. Tentacles about 60 to 80, with blackish basal bulbs, and without spurs. A large black ocellus upon the inner side of nearly all the basal bulbs. A single cordylus between every two tentacles. Cirri present.

Size :—Umbrella up to 6 millims. in diameter.

Locality :—Off Mutwal Island, West Coast of Ceylon, 12 specimens on March 19; and Galle, 3 specimens, on July 15.

Notes.—The collection contains 15 specimens which are about 5 millims. to 6 millims. in diameter and about the same age. The distance to which the gonads extend from the stomach along the radial canals varies in different specimens. Some have the

gonads on the proximal half of the canals, whilst in others the gonads reach nearly to the margin of the umbrella. The gonads first arise in the proximal part of the canals quite close to the stomach, and grow outwards towards the periphery of the umbrella. Owing to the great extension of the walls of the radial canals in the region occupied by the gonads, it is difficult in some specimens to mark the spot where the stomach ends and the canals begin. The gonads look as if they were situated upon lobes of the stomach. The length of the gonads is independent of the development of the generative cells, as a gonad extending over only half the radial canal has large ripe ova. Sections show (fig. 10) that the ova at an early stage in their development are among the endoderm cells, and that later on they move outwards to the ectoderm. The section figured shows an ovum leaving the ovary and breaking through the ectoderm.

The tentacles are closely packed together round the margin of the umbrella, and apparently form two alternating series, one projecting outwards and the other hanging down. Although similar in structure, only those belonging to the former have a conspicuous blackish basal bulb with a conspicuous black ocellus. The latter series have a smaller basal bulb, either colourless or slightly pigmented, and either without an ocellus or with a very small one. The basal bulb is on the inner side of the tentacle ; it is a semi-circular thickening containing nematocysts and granules of pigment, which cover the exterior of the bulb and also extend in radiating lines into the interior. There is no spur-like projection at the base of the tentacles. The cirri (fig. 9) are capable of extending to a great length. There is probably one between every two tentacles, but very few were seen on the specimens. The free end terminates in an oval knob containing large nematocysts (fig. 11). The ocellus is situated on the margin of the basal bulb just below the velum. It is of an intense black colour, spherical in shape, with a circular pit penetrating nearly to the centre (fig. 8).

The cordylus is very small and club-shaped (fig. 9). The interior of club is composed of endoderm cells which are connected with endoderm cells of the circular canal (fig. 7). The structure of the cordylus resembles that of *Laodice calcarata* (see Brooks, 1895).

The specimens from Ceylon come nearest to *Laodice calcarata* which inhabits the North Atlantic. They differ from it in having no spur at the base of the tentacles, in having larger ocelli, and perhaps in colour and in size.

Family: EUCOPIDÆ, Gegenbaur, 1856.

Mitrocomium, Haeckel, 1879.

Mitrocomium assimile, n. sp.—Plate I., fig. 3.

Description.—Umbrella fairly thick, a little broader than high. Velum narrow. Stomach short, with a quadrangular base. Four radial canals. Gonads upon the outer half of the radial canals, forming large oval sacs. Four perradial tentacles.

About 5 to 7 marginal bulbs in each quadrant; the central, interradial, bulb being much larger than the others. A cluster of cirri adjacent to and on each side of the tentacles. About five marginal sensory vesicles, each with two (occasionally three) otoliths, in each quadrant of the umbrella.

Size:—Umbrella 2 millims. in width and $1\frac{1}{2}$ millims. in height.

Locality:—Cheval Paar, in February.

Notes.—There is only one specimen of this little medusa in the collection. It is rather opaque with a yellowish stain, and its margin is badly curled inwards. The umbrella is somewhat contracted, so that it may not be quite so highly arched as figured. The stomach is contracted back. The mouth is wide open and quadrangular in outline, but has probably four lips when closed. The gonads (male) are very large for the size of the medusa. Each gonad is divided into two by a median longitudinal line. The tentacles have large basal bulbs and transverse bands of nematocysts. The cirri are more or less contracted, and have a small terminal cluster of nematocysts. The cirri are apparently confined to the proximity of the tentacles and none were seen scattered along the margin of the umbrella.

As there is only one specimen, I place the species provisionally in the genus *Mitrocomium*. It bears a resemblance to *Mitrocomium cirratum* in having cirri clustered at the base of each tentacle. According to HAECKEL'S definition of the genus it should have 8 tentacles and 16 sense-organs.

Eutima, McCRADY, 1858.

Eutima curva, n. sp.—Plate III., figs. 1 to 3.

Description.—Umbrella probably hemispherical, nearly twice as broad as high, moderately thick. Peduncle of the stomach long, quadrangular in transverse section, and with a conical base. Stomach small, about twice as long as broad. Mouth with four small lips, and sinuous margin. Four radial canals. Gonads along nearly the whole length of the peduncle, one on each radial canal, beginning a little way below the conical base of the peduncle and terminating not far from the stomach. Four perradial tentacles, with long tapering cone-shaped basal bulbs, which are laterally compressed and curve over the margin of the umbrella. About 30 to 35 marginal bulbs in each quadrant of the umbrella, and alongside each bulb usually one, occasionally two cirri. Eight adradial marginal sensory vesicles, each with about 8 to 10 otoliths, which are arranged in a semicircle.

Size:—Umbrella 10 millims. in width and 6 millims. in height. Peduncle about 10 millims. in length.

Locality:—Off Mutwal Island, West Coast of Ceylon, on March 19.

Notes.—The single specimen, although in a good state of preservation, has the umbrella badly compressed and folded, so that it is impossible to figure the whole medusa. It is an adult, as the gonads contain large ova. The basal bulbs of the

tentacles are attached to a slight thickening of the umbrella and curl over the margin. The nematocysts along the tentacle are arranged in transverse bands which do not quite meet on the inner side of the tentacle, so that a shallow groove is formed along the inner side, running the whole length of the tentacle. The marginal bulbs have a patch of blackish pigment at their apex.

This species comes nearest to *Eutima mira* and *Eutima insignis*, but is distinguished from them by the shape of the basal bulbs.

Octorchis, Haeckel, 1864.

Octorchis orientalis, n. sp.—Plate III., fig. 4.

Description.—Umbrella probably hemispherical, a little broader than high, and moderately thick. Peduncle of the stomach long, quadrangular in transverse section, and with a broad roundish base. The length of the peduncle is about twice the diameter of the umbrella. Stomach small, about as long as broad. Mouth with four short lips and a deeply folded margin. Gonads upon the peduncle of the stomach and also upon the sub-umbrella. The gonads occupy the greater length of the peduncle, extending along the radial canals, beginning a little way below the base of the peduncle and terminating close to the stomach. The gonads upon the sub-umbrella usually occupy the central third of the radial canals, or the outer half, but do not reach to the margin of the umbrella. Four long perradial tentacles, with long tapering cylindrical basal bulbs. About 18 to 20 marginal bulbs in each quadrant of the umbrella, each one with a lateral cirrus. Eight marginal sensory vesicles.

Size :—Umbrella about 5 millims. to 6 millims. in diameter.

Locality :—Galle Bay, one specimen on June 5, seven on June 12, and two on August 21.

Notes.—None of the specimens are in good condition, the umbrella being so flattened out and crumpled that it is not possible to draw a figure of it. Some of the largest specimens have the gonads upon the peduncle in a series of folds (fig. 4), but it is possible that the folding may be due to the contraction of the peduncle. The gonads upon the peduncle are much larger and longer than those upon the sub-umbrella, the latter forming merely a thin narrow band along the radial canals. The marginal bulbs are very small and inconspicuous. The cirri are very slender and have a small terminal cluster of nematocysts. The sense-organs are situated near the tentacles. They are very small and globular in shape, their otoliths not visible.

Notes on Intermediate Stages.

(*a.*) Umbrella about 2 millims. in diameter. Peduncle about 5 millims. in length, with gonads just appearing upon it. Four tentacles. Cirri present. About 9 marginal bulbs in each quadrant. Eight sense-organs.

(*b.*) Umbrella about 3 millims. in diameter. Peduncle about 6 millims. in length. Gonads just appearing upon the peduncle and sub-umbrella. About 12 marginal bulbs in each quadrant.

This species does not agree with HAECKEL'S definition of the genus *Octorchis*, since it has only 4 instead of 8 tentacles, but in other respects it conforms to the generic character. *Octorchis gegenbauri* has been frequently taken by me in British seas. Early and intermediate stages (the latter often with gonads) have 4 tentacles, whereas the fully developed adult has 8 tentacles. I think it would be better to enlarge the generic character so as to include species with 4 and 8 tentacles, than to establish a new genus for species which have only 4 tentacles.

HAECKEL, in his monograph, mentions two species of *Octorchis*—*O. gegenbauri* and *O. campanulatus*, both occurring in the Mediterranean, but probably there is only one species. The specimens from Ceylon are distinguished from the Mediterranean species by the greater length of the gonads on the peduncle.

Irene, ESCHSCHOLTZ, 1829.

Irene ceylonensis, n. sp.—Plate III., figs. 9 to 11.

Description.—Umbrella probably watchglass-shaped, much broader than high, with thin walls. Velum narrow. Stomach short, situated upon a long cylindrical peduncle. Mouth with four lips, which have a folded margin. Four radial canals. Gonads linear, extending from the base of the peduncle to near the margin of the umbrella. Tentacles about 100. Cirri absent. Sensory vesicles, one between every two tentacles, each vesicle with a single otolith.

Size:—Umbrella up to about 25 millims. in diameter.

Locality:—Galle Bay, one specimen on July 15; Cheval Paar, five in November.

Notes.—The collection contains six specimens differing in age and size, the smallest being about 5 millims. in diameter. All the specimens are more or less damaged. They are in a fair state of preservation, but are stained dead black, probably owing to the use of osmic acid.

The umbrella is flat and thin, but is no doubt slightly curved when the medusa is alive. Only one specimen shows the peduncle fairly well, the others have either lost it or have it twisted up. The gonads form thin narrow bands, either straight or sinuous, extending along the radial canals over the sub-umbrella. In the largest specimens the ova are large and clearly visible. Some of the specimens have a marginal bulb between some of the tentacles, and these bulbs I believe to be the origin of new additional tentacles, and not warts or tubercles, which do not develop tentacles. I am doubtful about the presence of excretory pores at the back of the basal bulbs, as there were no indications of papillæ, but they may be contracted.

The sensory vesicles have one otolith, but occasionally a vesicle was seen with two otoliths, which may have been caused by twinning.

(*a*)	Umbrella about	5	millims. in diameter.	About	28	tentacles.
(*b*)	,, ,,	7	,, ,,	,,	36	,,
(*c*)	,, ,,	15	,, ,,	,,	72	,,

Irene palkensis, n. sp.—Plate III., figs. 12 to 16.

Description.—Umbrella watchglass-shaped, about four times as broad as high. Velum narrow. Stomach short, situated upon a long cylindrical peduncle. Mouth with four short lips, which have a folded margin. Four radial canals. Gonads linear, extending from the base of the peduncle to near the margin of the umbrella. Tentacles about 50. Usually two or three marginal bulbs between every two tentacles. Excretory pores opposite the basal bulbs of the tentacles and all the marginal bulbs. Sensory vesicles about 2 to 4 between every two tentacles, each vesicle with two otoliths (variation 1 to 4).

Size :—Umbrella up to 20 millims. in diameter.

Locality :—Palk Bay, north of Ceylon, five specimens on March 16.

Notes.—The five specimens are all in a damaged condition, especially as to the gonads and the margin of the umbrella. The smallest is about 15 millims. in diameter and the largest about 20 millims. The gonads are upon the sub-umbrella along the radial canals. One specimen has the gonads extending from near the margin of the umbrella up to the peduncle, and for a short distance down the peduncle. The number of tentacles is only given from an estimation, as not one specimen has even a quadrant of the margin of the umbrella in a perfect condition. The basal bulb of the tentacle is somewhat globular when the tentacle is contracted, and more cone-shaped and tapering when the tentacle is expanded. On the inner side of the basal bulb just above the velum there projects an excretory pore. These pores are conspicuous and clearly visible when expanded, but almost invisible when contracted. Cirri were specially searched for, but none were seen. The marginal bulbs are small, and to judge from their appearance in one of the specimens, I think that some are capable of developing tentacles. Their number between every two tentacles is variable, usually two or three, sometimes only one. All these bulbs have excretory pores, similar to the pores opposite the basal bulbs of the tentacles. The sense-organs are closed vesicles with generally two otoliths (fig. 14), occasionally three to four otoliths, rarely one. The otoliths possess well-marked eccentric zones, which are conspicuous in specimens which have been apparently killed with a re-agent containing osmic acid.

At first sight *Irene palkensis* and *Irene ceylonensis* look very much alike, but after an examination of the organs on the margin of the umbrella I came to the conclusion that they were distinct species. *Irene ceylonensis* has about twice as many tentacles without a series of marginal bulbs in between them, and there is a difference in the shape of the basal bulbs of the tentacles, but I attach more importance to the sense-

organs as a better means of distinguishing between the two species. *Irene ceylonensis* has only one sense-organ between every two tentacles, each sense-organ with a single otolith. *Irene palkensis* has two to four sense-organs between every two tentacles, and each sense-organ usually has two otoliths, occasionally three to four, and rarely one. There is also a difference in the structure of the otoliths.

Irenopsis, Goette, 1886.

Eucopidæ with numerous sensory vesicles, and with numerous tentacles. Six gonads in the course of six radial canals. Stomach upon a peduncle.

Irenopsis hexanemalis, Goette, 1886.—Plate I., fig. 4; Plate III., figs. 5 to 8.

Irenopsis hexanemalis, Goette, 1886, p. 832; Chun, 1896, p. 5.
Phialidium tenue, Browne, 1904, p. 730, plate liv., fig. 4; plate lvii., fig. 16.

Description.—Umbrella like an inverted basin in shape, with a flattened top, about twice as broad as high. Velum narrow. Stomach short, with six lateral lobes, situated upon a short, broad, cone-shaped or semi-globular peduncle. Mouth with six lips, having a deeply-folded margin. Six radial canals. Gonads linear, on the distal part of the radial canals, close to the margin of the umbrella. Tentacles, about 30 to 40. Marginal bulbs about three or more between every two tentacles. Excretory pores opposite the basal and marginal bulbs. Sensory vesicles, usually one, sometimes two, between every two bulbs, each vesicle containing a single otolith (occasionally about two to four). Cirri absent.

Size :—Umbrella up to about 18 millims. in diameter.

Locality :—Palk Bay, 18 specimens on March 16; Cheval Paar, 9 specimens.

Notes.—The collection contains about two dozen specimens and nearly all are in bad condition. The smallest is an intermediate stage measuring 5 millims. in diameter. The stomach is situated upon a short peduncle which is about 2 millims. to 4 millims. in length. The peduncle is variable in shape. In some specimens it is conspicuous, but in others hardly noticeable. When semi-globular, or like a broad inverted cone, it is quite recognisable. In some of the specimens the peduncle is flattened out (whether this is natural or due to preservation I am unable to say), and in this condition the roof of the sub-umbrella appears convex, and the top of the umbrella is very thick. The stomach (fig. 8) is divided into six lobes, and its base seen aborally is like a six-rayed star. It is very short, about 1 millim. in length, and about twice as broad as long. The mouth has six conspicuous lips, which are continuous with the lobes of the stomach, and the margin of the lips is deeply and closely indented with a series of folds. In some specimens the stomach and its peduncle are within the cavity of the sub-umbrella, but those specimens which have an extra thick umbrella may have the stomach projecting a little way outside the cavity.

When a medusa has normally six radial canals, a variation in number may be expected. Medusæ with six radial canals have been derived from a form with four canals, and are much more liable to variation than those with four canals. There are altogether 27 specimens of *Irenopsis*, and six show a numerical variation in the radial canals, their numbers being as follows;—4, 7, 8, 8, 9, 11. The number of gonads also varies with the radial canals. The gonads vary very much in size, and are always situated upon the distal or outer half of the radial canals. Most of the specimens have very short linear or spindle-shaped gonads, about 1 millim. or little more in length, and situated near the margin of the umbrella. Three specimens have the gonads extending over nearly the whole of the distal half of the canals, but not quite reaching to the margin of the umbrella.

The tentacles vary in number according to the size and age of the specimens. The exact number in any one specimen could not be ascertained, as all the specimens have the margin of the umbrella more or less damaged. As a rule, in the largest specimens, there are about five or six tentacles (one specimen has six or seven) between every two radial canals. I estimated the number of tentacles in several large specimens to be about 36, and in one specimen at about 40. About the exact shape of the basal bulbs of the tentacles I am uncertain. In a contracted state they look somewhat globular, but are probably more conical when the tentacle is expanded. The marginal bulbs between the tentacles are very minute and their number is variable. Usually about three are present, but occasionally only one between every two tentacles. There are excretory pores opening above the velum, opposite every basal and marginal bulb. In nearly every specimen these pores are so contracted that their presence is not noticeable. In a few specimens they are well expanded (fig. 5) and form long papillæ. The marginal sense-organs (fig. 7) are closed vesicles, usually with a single otolith, but occasionally with two or three otoliths, rarely with four. There is generally only one between every two marginal bulbs, or about two to four between every two tentacles.

The genus *Irenopsis* was established by GOETTE for *Irenopsis hexanemalis*, found at Zanzibar. The original description is rather brief and there is no figure. CHUN, however, has given a fuller account of some specimens taken at Tumbatu, off Zanzibar. The genus clearly belongs to the sub-family Irenidæ, and is readily distinguished by the presence of six radial canals. As the specimens from Ceylon agree with the descriptions given by GOETTE and by CHUN, I have presumed that they are *Irenopsis hexanemalis*, though I should have liked to see a figure for comparison.

After seeing these specimens of *Irenopsis* I again examined *Phialidium tenue*, which was described by me as a new species in the Report on the Hydromedusæ of the Maldive Islands. The description of this species, based upon a single specimen, was given as follows:—"Umbrella watch glass-shaped and thin. Stomach small, quadrangular in shape, and situated on a semi-globular thickening of the umbrella.

Mouth with four lips and a sinuous margin. Four gonads extending over the outer half of each radial canal. Tentacles 25 in number. One or two minute marginal bulbs between every two tentacles. Sense-organs numerous, one or two, rarely three, between every two tentacles, with a single otolith. Umbrella 15 millims. in diameter." I clearly pointed out that I did not regard the thickening of the umbrella as a definite peduncle, and consequently placed the species in the genus *Phialidium* instead of in *Irene*. The result of the second examination, with specimens of *Irenopsis* for a comparison, leaves no doubt that the thickening of the umbrella must be regarded as a peduncle, so that the species does not belong to the genus *Phialidium*. It resembles *Irenopsis* in the shape of the peduncle, in the position of the gonads, in the number of tentacles, marginal bulbs and sense-organs. The basal bulbs of the tentacles are slightly larger. But it has only four radial canals, four gonads, and a mouth with four lips. If the specimen had been in this collection I should certainly have considered it to be an abnormal *Irenopsis*, having four instead of six radial canals. With four radial canals one would expect to see a mouth with four lips. I think that *Phialidium tenue* had better be regarded as an abnormal *Irenopsis*.

Octocanna, HAECKEL, 1879.

Octocanna polynema (HAECKEL)—Plate II., figs. 8, 9, 10.

Description.—Umbrella about twice to three times as broad as high, and thick. Stomach flat, octagonal base with eight lateral lobes, about 2 millims. in diameter. Mouth with eight small lips. Eight radial canals. Gonads linear, extending over the outer half of the radial canals and nearly reaching to the margin of the umbrella. Sixteen tentacles. About three to four marginal bulbs between every two tentacles, each having an excretory pore. One marginal sensory vesicle (seldom two) between every two bulbs, each vesicle with two otoliths (rarely with one or three).

Size :—Umbrella up to 12 millims. in diameter.

Locality :—Palk Bay, one on March 16; off Mutwal Island, one on March 19; Galle, one on August 25.

Notes.—The umbrella of two specimens is plano-convex in shape, fairly thick, and its margin is curled inwards. The third specimen has a very thick umbrella, which is more highly curved than those of the other two specimens, and the cavity of the umbrella is very shallow. The stomach has eight lobes, from which run the radial canals. The mouth is expanded in all the specimens and has eight small lips, corresponding in position to the radial canals. The gonads, in two of the specimens, are on the outer half of the radial canals, but in the third specimen they are more central, occupying the central third of the radial canals. They are linear in shape, increasing in thickness towards the distal end, and show fairly large ova. There are eight tentacles in the smallest specimen (8 millims. in diameter), one opposite each

radial canal, and eight large marginal bulbs, one midway between every two tentacles. A few of these bulbs are just beginning to develop tentacles. The tentacles are long and slender, and their basal bulbs are somewhat globular. The excretory papillæ are plainly visible, and project out just above the velum. All the basal bulbs and the small marginal bulbs have excretory pores. The small marginal bulbs are more or less conical in shape, and some look as if they were capable of developing tentacles.

I place this species provisionally in the genus *Octocanna*, as it does not possess all the characters according to HAECKEL's definition. There are two species of *Octocanna*, both of which were described, without figures, by HAECKEL, and have not since been recorded.

Octocanna octonema has 8 tentacles. Gonads reaching along the whole length of the radial canals. Sixteen sense-organs, each with a single otolith. Umbrella 10 millims. in diameter. Red Sea.

Octocanna polynema has 32 tentacles. Gonads not along the whole length of the radial canals. 60 to 80 sense-organs, each with two otoliths. Umbrella 15 millims. in diameter. Singapore.

Both the above species have four very long oral lips, which HAECKEL includes in the generic characters. The Ceylon specimens have eight small lips. They also possess marginal bulbs and excretory pores which are not mentioned by HAECKEL.

[In the report upon the Hydromedusæ of the "Siboga" Expedition, Professor MAAS describes under the name of *Octocanna polynema*, HAECKEL, some medusæ which appear to me to be identical with the specimens in the Ceylon collection. These specimens I had described in manuscript as a new species of *Octocanna*. As MAAS has emended HAECKEL's description and transfers the genus from the Æquoriidæ to the Eucopidæ, he has prevented me from introducing a superfluous new species. I quite agree with him as to the desirability of the removal of the genus to the Eucopidæ and have adopted the classification here.]

FAMILY: ÆQUORIIDÆ, ESCHSCHOLTZ, 1829.

Æquorea, PÉRON et LESUEUR, 1809; ex BROWNE, 1904.

Æquoriidæ with numerous simple unbranched radial canals. Stomach circular, with the lower wall fully developed. Mouth capable of closing up.

Æquorea conica, n. sp.—Plate I., fig. 2; Plate II., figs. 16, 17, 18.

Description.—Umbrella somewhat cone-shaped, with a rounded summit, a little higher than broad, and very thick. Velum narrow. Stomach flat and circular, about half the diameter of the umbrella. Oral lips about 16 in number, long and slender. About 16 radial canals. Gonads upon the proximal half of the radial canals, very much laterally compressed. Tentacles about 26 to 30, small and slender; their basal bulbs small and somewhat cone-shaped. Between every two tentacles a

very minute marginal bulb and two sensory vesicles (sometimes only one), each with two small otoliths.

Size :—Umbrella up to 7 millims. in width and 8 millims. in height.

Locality :—Pearl banks, Gulf of Manaar.

Notes.—The collection contains six specimens, which are mostly about the same size (5 millims. in width and 6 millims. in height) and age. Some are males and others are females having gonads with large ova. The oral lips have an external rib, with an internal groove which is probably ciliated. In this species the gonads are confined to the proximal half of the radial canals, and hang down as laterally compressed sacs. It is upon the position and shape of the gonads that I base the specific character. Excretory pores along the circular canal are not visible. Four of the specimens have 16 radial canals and 16 oral lips, one specimen has 15 canals and another 18 canals.

Æquorea parva, n. sp.—Plate II., figs. 5, 6, 7.

Description.—Umbrella plano-convex in shape, a little broader than high, very thick. Velum of moderate width. Stomach flat and circular, about one-third the diameter of the umbrella. Oral lips 13 to 16 in number, of moderate length and width. Radial canals 13 to 16. Gonads sac-like, in the central third of the radial canals. Four (perhaps eight) tentacles, with large basal bulbs. About 12 or more marginal bulbs between every two tentacles. About 10 or more marginal sensory vesicles between every two tentacles, or usually one between every two bulbs; each vesicle with two small otoliths.

Size :—Umbrella up to 6 millims. in width and 4 millims. in height.

Locality :—Galle Bay, one on June 5 and two on June 12.

Notes.—The three specimens are about the same size and age. One is a female and the other two are males. The stomach is about 2 millims. in diameter, and its lower wall about 1 millim. in width; the oral lips do not exceed 1 millim. in length. The gonads have lost their original shape, as they have been crushed down by the folding in of the margin of the umbrella. They occupy the central part of the radial canals, and are slightly nearer to the margin of the umbrella than to the stomach. The gonads hang down as sacs, somewhat laterally compressed. The female has large ova. One specimen has 13 radial canals, gonads and oral lips; the other two have 16 radial canals, gonads and lips. Two specimens have only four tentacles, but the third specimen has one interradial bulb which is just developing a tentacle. The interradial bulbs are much larger than the other bulbs and probably have tentacles in a fully developed specimen. The marginal bulbs, which are very variable in size, are somewhat cone-shaped and contain nematocysts. Some of the bulbs have an excretory pore opening on the sub-umbrella just above the velum. One specimen is badly infested with Cercaria.

This little *Æquorea* differs from the other species of the genus in the small numbers of its tentacles, and in the shape and position of the gonads upon the radial canals.

Mesonema, Eschscholtz, 1829; ex Browne, 1904.

Æquoriidæ with numerous simple, unbranched radial canals. Stomach circular, with lower wall quite rudimentary. Mouth nearly as large as the diameter of the stomach and cannot be closed.

Mesonema pensile (Modeer), 1791—Plate II., figs. 11 to 15.

Medusa sp., Forskål (1776, p. 9, tab. xxviii. b.).
Mesonema cœlem pensile, Modeer (1791, p. 32).
Mesonema pensile, Haeckel (1879); Browne (1904, p. 733, pl. lv., fig. 4; pl. lvii., figs. 2–9).

In my Report upon the Hydromedusæ of the Maldive Islands I gave a description of *Mesonema pensile* (Modeer). In this Ceylon collection there are fragments of a specimen which I believe belongs to this species. The specimen is from the Cheval Paar, Gulf of Manaar, and is broken up into about twenty-five pieces, which together represent only a portion of the whole medusa. Fortunately some of the fragments contain all the organs of the medusa, and it is possible, within certain limits, to give a description and to identify the species.

This medusa is so peculiarly constructed that all the organs lie close to the margin of the umbrella. The umbrella is rather like a plano-convex lens in shape and of great thickness. Around its periphery lie the mouth, stomach, radial canals, marginal tentacles, and sense-organs. These organs are all close together, the distance from the oral lips to the margin of the umbrella is only about 20 millims. To judge from the curvatures of the stomach and the margin of the umbrella on the three largest fragments (the largest fragment which contained all the organs measures 35 millims. in length), the diameter of the umbrella should be much larger than that of the largest Maldive specimen, which measured about 60 millims. in diameter. I think that this medusa when alive was probably about twice the size of the largest Maldive specimen.

The stomach (fig. 14) is rudimentary, and its lower wall is about 4 millims. in length. The margin of the mouth is furnished with a large number of long narrow lips, which are strengthened by an external rib. The length of the longest lips is about 4 millims. Among the lips there are many small ones in the course of development. In structure and shape the oral lips are exactly like those of the Maldive *Mesonema*, but they are a little longer. The lower wall of the stomach is also longer, twice the length.

The radial canals are very numerous, and very short; the distance from margin of the stomach to the circular canal is about 9 millims. The radial canals usually run straight from the stomach to the circular canal, and in one fragment the canal system is quite normal, but some fragments show that the short portion of the canals,

between the termination of the gonads and the circular canal, has a strong tendency to curve and to send out lateral branches, which occasionally unite with lateral branches from an adjacent canal, or the union of two or three canals may occur, so that just near the margin of the umbrella the radial canal system appears to be very irregular.

The gonads are situated upon the radial canals and extend almost from the stomach to within a short distance of the circular canal, the distance from the termination of the gonad to the circular canal being about 2 millims. to 3 millims. The gonads are arranged in a lateral band along each side of the radial canals. At first a radial canal is merely a narrow, slender, inconspicuous tube (fig. 14, *R.*), then when the gonads begin to develop, the wall of the canal becomes thicker and increases in size. In this specimen the gonads are much larger than in the Maldive specimens. They have the appearance of cylindrical sacs, about 6 millims. in length and 1 millim. in diameter, with the wall slightly crumbled. Between the canals bearing the fully-developed gonads there are, here and there, canals which are of much later growth showing gonads in various stages of development. Some of these canals are at about the same stage as those in the Maldive specimens, showing that the Maldive specimens had not reached their full development.

The tentacles (fig. 12) belong to the same type as those of the Maldive specimens, but the basal bulbs have not such a long lateral extension along the margin of the umbrella. I have again examined the tentacles of the Maldive specimens, and find the extension along the margin to be slightly variable. The tentacles are also much longer and larger than those in the Maldive specimens, but they have the nematocysts arranged in the same manner. The nematocysts are in large clusters, which are laterally situated, on both sides, along the whole of the tentacle (fig. 13).

The marginal bulbs, like the basal bulb, at first sight, as shown by the figures in this Report and in the Maldive Report, do not appear to be similar, but I believe that the difference in general appearance is due to a lateral contraction of the margin of the umbrella of the specimen in this collection. The bulbs are closely packed together, touching one another, and the sense-organs are squeezed out on to the inner margin of the umbrella (fig. 15). This lateral contraction would also explain the shortness of the basal bulbs of the tentacles upon the margin. In the genus *Æquorea*, excretory pores are present upon the inner side of the circular canals, one opposite each tentacle or bulb. In my description of this species in the Maldive Report I did not mention the excretory pores, for the simple reason that I could not see any. But I have now cut a series of sections of a marginal bulb and found the pore in the usual place just above the velum. There is no trace of any external papilla or swelling, but simply a slender, narrow tube running from the circular canal to the exterior. It is just like a slit in the wall of the circular canal.

The sense-organs (fig. 15) are on the inner side of the margin of the umbrella, and are arranged in groups These groups are placed midway between the marginal

bulbs. Between two tentacles I counted the number of bulbs and sense-organs, and found that there were 10 bulbs and 20 sense organs. The latter were arranged in numbers thus: 1.1.2.3.1.1.1.2.2.2.2.2. From the examination of other groups of sense-organs it may be said that there are either one or two, rarely three sense-organs between every two bulbs. A sense-organ contains two otoliths. The figure (11) shows the shape of the vesicle and the position of the otoliths, but the minute details of structure are somewhat diagrammatic.

It is impossible to estimate the number of tentacles, radial canals, &c., which the specimen should have, as the fragments are only a portion of the whole medusa. The tentacles are about 5 millims. to 8 millims. apart, and between them there are about 8 to 12 marginal bulbs, and about 4 to 8 radial canals.

Distribution :—Indian Ocean.

Order : TRACHOMEDUSÆ.

Family : OLINDIIDÆ, Haeckel, 1877; ex Browne, 1904.

Gonionemus, A. Agassiz, 1862.

Gonionemus hornelli, n. sp.—Plate I., fig. 6; Plate II., fig. 4.

Description.—Umbrella hemispherical, with moderately thick walls, about twice as broad as high. Velum fairly broad. Stomach cross-shaped, having four perradial lobes, situated upon a short, broad, cone-shaped peduncle. Mouth with four short lips. Four broad radial canals, upon which are situated the gonads. Gonads small in size, deeply folded and lobed, extending laterally from the canals and close to the velum. Tentacles about 70, arranged in 16 groups, and all have an adhesive disc about half-way down. Sixteen internal sense-organs, oval in shape, with a single otolith.

Size :—Umbrella 6 millims. in width and 3 millims. in height.

Locality :—Pearl Banks, Gulf of Manaar.

Notes.—The single specimen is in an excellent state of preservation and in perfect condition. The gonads are not papilliform, but are deeply folded and extend outwards on both sides of the radial canals. They are about twice as broad as high, and contain ova of a fair size. On one of the radial canals there is an additional gonad, smaller in size, and not far from the stomach. It may be regarded as an abnormal growth, as the other three canals show no signs of a gonad in that position.

The tentacles are arranged in 16 groups, but the grouping is not so well marked as in the genus *Gossea.* The tentacles forming a group are not of the same size, which is due to development. The perradial and interradial groups each contain five tentacles, the adradial four tentacles. The central tentacle in each group is the largest, the tentacles on each side of the central one come next in size; the two outside tentacles vary very much in size, one is always very small. The attachment

of the basal part of the tentacle to the ex-umbrella varies in length according to the age of the tentacle. It proceeds furthest up the umbrella in the oldest tentacles and less far in the other tentacles, showing well the arrangement of the tentacles in groups. There is a semi-globular basal bulb on the inner side of each tentacle, and for a short distance the base of the tentacle is attached on its outer side to the margin of the ex-umbrella, being partly embedded in a groove. The tentacles are covered with nematocysts, which are arranged in transverse bands. The adhesive disc is on the outer side of the tentacle, forming a slightly raised elongated loop, and as it extends about half-way across the tentacle it is easily seen. All the tentacles of this specimen are contracted, and in this condition the adhesive disc is about half-way down the tentacle.

The sense-organs are inside the margin of the umbrella, adjacent to the circular canal, and their position is between the groups of tentacles.

Olindias, F. Müller, 1861.

Olindias, sp. ?

There is only one specimen, which is in bad condition. The umbrella is about 6 millims. in diameter. The stomach is fairly large and cross-shaped. The mouth has four lips and its margin is slightly folded. Four perradial canals, and about three centripetal canals in each quadrant. The gonads extend over the outer half of the radial canals and are arranged in papilliform clusters. The margin of the umbrella is torn and damaged. There are two kinds of tentacles; the primary tentacles have a few spiral bands of nematocysts and a horseshoe-shaped terminal cluster, the secondary tentacles have numerous bands of nematocysts. Upon the margin of the umbrella there are a number of large bulbs which look like the basal bulbs of the secondary tentacles which have been broken off, and also a number of small bulbs. An internal sense-organ lies at the base of some of the primary tentacles, but this could only be seen here and there, owing to the opaqueness and damaged condition of the margin.

The specimen may be *Olindias singularis*, found at the Maldives, but it is not in a condition suitable for an accurate determination of the species. It was found amongst sea-weed at Galle, on February 17.

Note on the Olindiidæ.

In my Report on the Hydromedusæ of the Maldive Islands I revised the genera of the Olindiidæ, but did not know till too late that Professor Seitaro Goto had published a paper on "The Craspedote medusa *Olindias* and some of its Natural Allies" in the 'Mark Anniversary Volume.' It was not until several months after the publication of my paper that I was able to obtain a copy of the volume, and later on Professor Goto kindly sent me a reprint of his paper.

Goto has also revised the Olindiidæ, but excludes from the family the genera

Aglauropsis and *Gossea*, which have not an adhesive disc on the tentacles. About the genus *Olindias* we differ, and it is quite likely that I may be in the wrong. We both examined specimens sent out from the Zoological Station at Naples. I came to the conclusion that the primary (ex-umbrellar) tentacles had not a terminal adhesive disc, but GOTO has expressed an opposite opinion. It is an important point in the classification and could, no doubt, be quickly settled by watching the habits of *Olindias* in the aquarium at Naples.

GOTO has investigated the development of the sense-organs of *Olindioides formosa*, GOTO, and has come to the conclusion that they are entirely derived from the ectoderm. On the ground that the sense-organ is ectodermal, GOTO transfers the Olindiidæ from the Trachomedusæ to the Leptomedusæ and places them under the Eucopidæ. In this Report I have left the Olindiidæ in their old place for convenience sake, not that I dispute GOTO's account of the development of the sense-organs, but rather that I am doubtful about their being true Leptomedusæ.

In 1901, when I was examining the medusæ brought back from the Falkland Islands by Mr. RUPERT VALLENTIN (I regret that the report on the collection is still unfinished, but hope to finish it next year), I cut some sections of the sense-organs of *Aglauropsis conantii*. The sense-organ lies in a corner, formed on one side by the ectoderm containing nematocysts on the margin of the umbrella, and on the other side by the endoderm of the circular canal. It is a globular vesicle containing an otolith upon a short stalk. The wall of the vesicle is composed of a single layer of cells which are in contact with the ectoderm, but isolated from the endoderm by what looks like a layer of mesoglœa. As this layer took a definite shape and stained a much deeper colour than the mesoglœa seen elsewhere, I, not knowing its origin, was doubtful about its really being mesoglœa. I was puzzled for a time over the sense-organ, not being sure whether the cells of the vesicle were ectoderm or endoderm, but finally came to the conclusion that the deeply-stained layer between the vesicle and the endoderm had some connection with the sense-organ and regarded the whole sense-organ as endodermal. As the sections showed that the preservation was not suitable for histological work (the specimens were preserved in formalin), I did not attempt to trace the development of the sense-organ.

After reading GOTO's description of the development of the sense-organ of *Olindioides*, I again examined the sections of *Aglauropsis*. I am now inclined towards the view that the vesicle is ectodermal, and that it is cut off from the endoderm by mesoglœa, but before coming to a definite conclusion I should like to see earlier stages in development.

FAMILY: GERYONIIDÆ, ESCHSCHOLTZ, 1829; ex MAAS, 1893.

Trachomedusæ, with four or six radial canals, in the course of which are situated leaf-shaped gonads. Blind centripetal canals. Stomach on a long peduncle. Internal sensory vesicles.

Liriope, LESSON, 1843 ; ex MAAS, 1893.

Geryoniidæ, with four radial canals and with four or eight tentacles.

Liriope tetraphylla (CHAMISSO et EYSENHARDT), 1820.

Geryonia tetraphylla, CHAMISSO et EYSENHARDT (1820, p. 357, plate xxvii.).
Liriantha tetraphylla, HAECKEL (1879).
Liriope tetraphylla, VANHÖFFEN (1902, p. 82, taf. x.); BROWNE (1904, p. 738, pl. liv., fig. 3).

The collection contains 19 specimens; only a few are in fairly good condition There are a few early and intermediate stages, but their condition is not satisfactory for a description. The largest specimens are similar to a figure given by VANHÖFFEN.

When I wrote the 'Report on the Hydromedusæ of the Maldive Islands' I was not quite certain about the correctness of the identification of a *Liriope* which I called *L. tetraphylla* (1904, plate liv.). I have again examined this specimen (there was only one in that collection) and have come to the conclusion that it must be regarded as *Liriope tetraphylla.* I have failed to find a character by which it could be specifically separated from those in the collection from Ceylon.

Notes on the Largest Specimens.—The shape of the umbrella is similar to that in the figure given by VANHÖFFEN, and is not so thick or so rounded as in that figured by me in the Maldive Report. The peduncle of the stomach is long and tapering; its length in the largest specimen is about 13 millims. Along the peduncle run four interradial, longitudinal muscle bands, which bifurcate at the base of the peduncle and the two ends curve outwards. The stomach is large and sac-shaped. The gonads vary very slightly in shape. They resemble VANHÖFFEN'S figure, and measure 7 millims. in width and 5 millims. in length. The space between the gonads (measured from the upper margins) is about 2 millims. The radial canals are fairly broad, and that part of the canal between the gonad and the circular canal is much broader than as figured by VANHÖFFEN and myself. Most of the specimens have three centripetal canals in each quadrant. They are broader and less tapering than those shown in the figures mentioned above. One of the specimens has only one or two centripetal canals in each quadrant. A few of the specimens have eight tentacles, but the majority have only the four perradial tentacles.

Size :—The largest specimen measures 15 millims. in width and 7 millims. in height.

Locality :—Cheval Paar, off Mutwal Island and Chilaw Paar, various dates in March and November; Galle Bay, in June and July.

Distribution :—Atlantic and Indian Oceans.

ORDER: NARCOMEDUSÆ.

FAMILY: ÆGINIDÆ, GEGENBAUR, 1856; ex MAAS, 1904.

Solmundella, HAECKEL, 1879 ; ex MAAS, 1904.

Æginidæ with two tentacles and with a stomach having eight pouches.

Solmundella bitentaculata (Quoy et Gaimard), 1833—Plate IV., figs. 1 to 6.

Charybdea bitentaculata, Quoy et Gaimard (1833, tome v., p. 295, plate xxv., figs. 4 and 5).
Æginella bitentaculata, Haeckel (1879).
Solmundella bitentaculata, Browne (1904, p. 741, plate lvi., fig. 3).

Description of the Adult.—Umbrella cone-shaped, usually a little broader than high. Stomach circular and flat, nearly as wide as the umbrella, having eight lateral pouches which are rectangular in shape and about twice as broad as high. Mouth circular, with an everted rim. Gonads on the inner wall of the pouches and also extending over the outer half of the lower wall of the stomach, forming a continuous band. Two opposite tentacles, which are situated above the stomach, and are about two to three times longer than the diameter of the umbrella. Peronial bands and grooves present. Sense-organs 24, perhaps more, usually three in each octant.

Size :—Umbrella up to 9 millims. in height and width.

Locality :—Galle, in February and August ; Modragam Paar and Cheval Paar, in November ; and Trincomalee.

Distribution :—Australasian seas ; Amboina Island (Quoy et Gaimard). Singapore (Bedford ; in Coll. E.T.B.). Indian Ocean ; Maldive Islands (Bigelow, 1904, p. 261, under the name of *Æginella dissonema* ; and Browne).

Notes.—The collection contains 39 specimens ; only a few are in good condition, and most of them are about 3 millims. to 5 millims. in diameter.

The umbrella is cone-shaped and nearly as high as broad. There is a slight variation in its shape, as the apex is more rounded in some specimens than in others. All the specimens have the apex of the umbrella more or less battered down so that it is impossible to note its exact shape, but it is not so pointed as that shown in the figure given by Quoy and Gaimard. The peronial groove below each tentacle is very deep, and goes right back to the wall of the sub-umbrella. The stomach is circular and flat and has eight lateral pouches. The upper wall of the stomach is either flat or slightly convex. The lower wall is also flat, with a circular mouth in the centre. The mouth, when fully expanded, is almost as wide as the diameter of the stomach. Its natural size is apparently about one-third to one-quarter the diameter of the stomach, but when closed the opening is very small. The margin of the mouth has an everted rim, and it does not usually hang down so low as in the specimen figured by me in the Maldive Report.

Haeckel, in his description of *Æginella dissonema*, and also Mayer (1900, p. 66, plate xiv.) state that there are four double perradial canals, each canal being divided into two by a longitudinal septum (called by Haeckel the peronium). The appearance of a double radial canal was seen in the two Maldive specimens, and also very plainly in some of the specimens in this collection, especially when the umbrella had been lightly stained. Transverse sections, however, do not confirm the presence of radial canals, and, after cutting several complete series, I have come to the conclusion that they are a delusion.

Description of the Peronia.—It is in the perradii, without the tentacles, that the appearance of a double canal is best seen, and transverse section in this position shows the "septum" but no canals (fig. 1).

In the two perradii, which have the tentacles, there is a longitudinal groove, the peronial groove, running from the margin of the umbrella up to the tentacle. This groove is very deep, running back to the wall of the sub-umbrella, cutting the wall of the sub-umbrella nearly in two (fig. 2). At the bottom of this groove is the peronial band (figs. 2 and 6), which runs from the margin of the umbrella to the base of the tentacle. The peronial band is a solid cord of ectoderm cells, nearly circular in transverse section, and surrounded by mesoglœa, except on the side facing the peronial groove. In the lower wall of the stomach there are two little funnel-shaped pockets, one under the root of each tentacle. Sections show that the ectoderm of the lower wall of the stomach, at the apex of the pocket, unites with the peronial band, and is continuous with the ectoderm of the tentacle. In the ectoderm of the tentacles there are large round nematocysts. These nematocysts form a conspicuous band along the under or lower side of the tentacle near its base (fig. 6) and then, a little further along, spread all round the tentacle. I have found similar nematocysts in the ectoderm of the pockets in the lower wall of the stomach and scattered among the generative cells (fig. 2) adjacent to the pockets. They are also in the strand of ectoderm between the apex of the pocket and the tentacle, but not in the peronial band, which is between this point and the margin of the umbrella. It seems to me that the nematocysts develop in the lower wall of the stomach in the neighbourhood of the pockets, then migrate into the ectoderm of the pocket and pass along the strand to the ectoderm of the tentacle.

The "septum" in the perradii, without tentacles, has the same structure as the peronial bands connected with the tentacles, but there is no peronial groove and the band ("septum") is completely surrounded with mesoglœa. It starts from the margin of the umbrella, runs up the side of the wall of the sub-umbrella, and at the level of the lower wall of the stomach it curves outwards and passes through the jelly to the ex-umbrella. In its passage through the jelly it tapers out almost to a point, and in some specimens stops a little way short of the ex-umbrella. Its presence marks the former existence of a tentacle, and shows that *Solmundella* is descended from a medusa which had four perradial tentacles.

The appearance of radial canals on each side of a "septum" is, in my opinion, due to the transparent mesoglœa in the short interval between the gastric pouches.

Sections across the margin of the umbrella do not show the existence of a definite circular canal.

Gonads.—Some of the specimens have the gonads confined to the inner wall of the gastric pouches, where they lie in the ectoderm (figs. 1 and 2). The gonads may extend over the lower half of each gastric pouch or over the whole pouch. Some of the large specimens have the gonads not only over the gastric pouches but

also over a part of the lower wall of the stomach, forming a continuous ring round the lower wall of the stomach just like the genital ring of a Solmaris. One specimen has the outer half of the lower wall of the stomach covered with ova, which are large and clearly visible; other specimens have only one quarter or one third of the wall of the stomach occupied with gonads. It appears from the specimens that the gonads first start developing at the bottom of the pouches, and then spread upwards and finally reach the lower wall of the stomach. The smallest specimens have the gonads confined to the pouches, but it is only in the largest specimens that the gonads are on the wall of the stomach.

Tentacles.—My figure of *Solmundella* in the Maldive Report shows that the base or root of the tentacles is curved outwards towards the ex-umbrella. This I now find is not the normal position, but the position occasionally taken when a specimen is in a contracted condition. As a rule the root of the tentacle points towards the centre of the umbrella (fig. 6), and in specimens which do not show signs of contraction it is sometimes clear of the upper wall of the stomach and the curve is scarcely visible. The tentacles have numerous internal transverse septa (fig. 5) which are connected in the centre by an elongated endoderm cell, containing usually two nuclei. The lower part of the tentacle (fig. 4) is somewhat triangular in shape; along this portion there is a longitudinal muscle band.

Sense-organs.—The smaller specimens have two sense-organs and the largest ones three and perhaps more in each octant. In certain octants I have seen extra bulbs without sense-organs, and these may be the bases of sense-organs which have lost the otolithic part through injury.

A few of the specimens are infested with a Cercaria.

SIPHONOPHORA.

Order: CALYCOPHORÆ, Leuckart.

Family: DIPHYIDÆ, Eschscholtz, 1829.

Diphyes, Cuvier, 1817.

Diphyes chamissonis, Huxley, 1859.

Diphyes chamissonis, Huxley (1859, p. 36, pl. i., fig. 3); Browne (1904, p. 742, pl. liv., fig. 6).

The collection contains eleven anterior nectophores, some of which are in very good condition. The specimens are similar to those which were described and figured by me in the 'Report on the Hydromedusæ of the Maldive Islands.'

One specimen is from Galle, in July, but all the rest were from the Gulf of Manaar, mostly in February and March.

The nectophores measure about 8 millims. to 11 millims. in length. The somatocyst

shows considerable variation in length and thickness. Some of the specimens have the somatocyst similar in shape and size to that shown in my figure of the species, whereas in other specimens it is longer (the length varies from 2 millims. to $3\frac{1}{2}$ millims.) and much thinner. The length of the hydrœcium is also variable, about one-third to half the length of the umbrella.

Order : PHYSOPHORÆ, Eschscholtz, 1829.

Family : AGALMIDÆ, Brandt, 1835.

Cupulita, Quoy et Gaimard, 1824.

There is one small specimen of a *Cupulita*, from the Cheval Paar, which is very much broken up. I am unable to determine the species.

Agalmopsis, Sars, 1846.

There are two small specimens, from the Cheval Paar, both of which are badly contracted and broken. The nectophores have all disappeared with the exception of a few minute buds, and only one damaged bract remains. The tricornuate tentilla are large and in excellent condition.

Family : PHYSALIIDÆ, Brandt, 1835.

Physalia, Lamarck, 1801.

Physalia utriculus, Eschscholtz, 1829.

Physalia utriculus, Huxley (1859, p. 101, pl. x., pl. xii., fig. 12); Browne (1904, p. 744).

Two small specimens were caught off Watering Point, Galle. The float is about 15 millims. in length. There is one main tentacle and several very small secondary tentacles. The gonophores are beginning to develop.

Family : PORPITIDÆ, Brandt, 1835.

Porpita, Lamarck, 1801.

Porpita is represented by the remains of a single float, obtained on the Pearl Banks, Gulf of Manaar, and measuring about 35 millims. in diameter. The upper surface of the float has numerous radial rows of stigmata on the back of prominent ridges. It resembles the float of *Porpita umbella*, which is figured by Haeckel (1888, plate xlv., fig. 5).

SCYPHOMEDUSÆ.

CHARYBDEIDA.

Charybdea, PÉRON et LESUEUR, 1809.

Charybdea, sp. ?

There is a single specimen in the collection from the pearl banks, and it is not in a first rate condition. The umbrella has become soft and limp, consequently it has collapsed and lost its natural shape. The umbrella measures about 75 millims. in length, and is probably cone-shaped. The stomach is very short and flat; the mouth has small lips. The gastric filaments appear to be perradial in position (the top of the umbrella is damaged and crushed in). Each of the four groups is composed of about six tufts of filaments packed so close together as to form a continuous row. The sense-organs are about 10 millims. away from the margin of the umbrella. There are four ocelli on the inner side of each tentaculocyst. The principal ocellus is very large and semi-globular in shape. Above it, a little nearer the base of the tentaculocyst, is a transverse ocellus, forming a narrow pigmented band. The other two ocelli are more lateral in position, and situated between the semi-globular and the transverse ocelli. The ocelli are of a reddish brown colour in formalin. The velarium contains seven unbranched canals between every two tentacles. The gonads form very narrow bands, and appear to be quite immature. The pedalia are about 20 millims. in length and 15 millims. in width. The shape of their wings and the tentacle resemble the figure of *Charybdea grandis* (AGASSIZ and MAYER, 1902, plate vi.).

This may be an immature specimen of *Charybdea grandis*, but I remain uncertain. A second specimen would have been an advantage for comparison.

CORONATA.

FAMILY: NAUSITHOIDÆ, HAECKEL, 1879; ex VANHÖFFEN, 1902.

Nausithoe, KÖLLIKER, 1853.

Nausithoe punctata, KÖLLIKER, 1853.

Nausithoe punctata, VANHÖFFEN, 1892, p. 13, Taf. iii., figs. 8 and 9; MAYER, 1900, p. 67, plate xxiii., figs. 67 and 68, plate xxvi., figs. 87 and 88; VANHÖFFEN, 1902, p. 29; BIGELOW, 1904, p. 263, plate vi., fig. 21.

Description.—The umbrella is somewhat hemispherical in shape. At the top of the umbrella there is a distinct hemispherical crown which is separated off from the

rest of the umbrella by a conspicuous circular furrow. Just below the circular furrow the radial furrows begin. There are 16 deep radial furrows on the ex-umbrella, one midway between every tentacle and sense organ, terminating at the base of the marginal lobes. The bottom of each furrow is attached to the wall of the sub-umbrella by a septum which divides the distal portion of the stomach into 16 pouches (8 ocular and 8 tentacular). The septum is continued for a little way down the middle of each marginal lobe, separating the prolongation of the stomach in each lobe into two parts. But as the septum does not proceed along the whole length of the gastric prolongation, two completely isolated pouches are not formed. The whole of the ex-umbrella, including the marginal lobes, is closely granulated.

The gastric filaments are arranged in four distinct groups, which are isolated from each other by the four basal angles of the cross-shaped mouth. There are about 10 to 12 filaments in each group arranged in a single row. Each group occupies the whole space between the angles of the mouth.

The mouth is large and cross-shaped, about 3 millims. in length and width.

The gonads vary in shape, and, looked at from the sub-umbrella, appear circular or oval. The largest are about 1 millim. in length and 0·75 millim. in width. Three specimens in one bottle have rose-red gonads, and two in another bottle are of an orange colour. All the specimens are in formalin. One is a male and four are females with large ova.

There are 16 marginal lobes, which are about as broad as long (2 millims.), and have a rounded edge. Between these lobes are the eight tentacles and eight sense-organs, which alternate with each other. The tentacles are of moderate length (about 5 millims.), stiff, and taper to a fine point. The sense-organs have an otolithic sac and a circular reddish pigmented ocellus.

The collection contains five specimens, three of which are in splendid condition. Two were from off Mutwal Island on March 19, and three from Muttuvaratu Paar on March 29. The largest measures 9 millims. in width and 7 millims. in height. Two specimens are 9 millims. in width and 5 millims. in height. The others are slightly smaller.

I have compared these specimens with *Nausithoe punctata* obtained from the Zoological Laboratory at Naples, and feel certain that they belong to this species; in fact, they agree in every detail except in the shape of the ocellus. The Naples specimens have a circular pigmented ocellus on a semi-circular or convex bulb, whereas in the Ceylon specimens the ocellus forms a pigmented ring on a bulb with a flat surface.

The results obtained by the "Valdivia" and "Siboga" Expeditions show that *Nausithoe punctata* has a very wide geographical distribution. It occurs in all the oceans. It was taken by the "Valdivia" off the east coast of Ceylon, and by BIGELOW at the Maldives.

DISCOPHORA.

SEMÆOSTOMATA.

Pelagia.

Pelagia, sp. ?

There are nine very young stages, the smallest 4 millims. in diameter and the largest 8 millims. They have eight tentacles and eight sense-organs. These specimens are too immature for me to identify, as they have not long passed through the Ephyra stage. They are all from the Cheval Paar, Gulf of Manaar.

RHIZOSTOMATA.

FAMILY: LYCHNORHIZIDÆ, MAAS, 1903.

Crambessa.

Crambessa, sp. ?

The collection contains two specimens, both from Galle Bay, June and August; one is in fairly good condition and the other is damaged.

Umbrella.—The umbrella is semi-globular, about twice as broad as high, and measures about 75 millims. in width and about 40 millims. in height. The ex-umbrella looks smooth, but a close examination with a lens shows that the surface is closely covered with very minute papillæ, which give it a granulated appearance. The ex-umbrella of one specimen has fine markings which look like a pattern produced by pressure against a tow-net. The pattern forms a network with a mesh of about half a millimetre.

Canal System.—There are eight ocular canals and eight adradial canals. The ocular canals run to the sense-organs, but the adradial canals stop at the circular canal and do not proceed to the margin. The circular canal, which is broad and conspicuous, is situated about 10 millims. from the margin of the umbrella. Between the circular canal and the margin of the umbrella the canal system forms a network of fine meshes. The ocular canals pass through this network and anastomose with it. On the inner side of the circular canal and between the radial canals there is a very coarse network of canals. This network is in communication with the circular canal, but not with the stomach. In one specimen there is a slight anastomosis of the inner network with some of the radial canals, but in the other specimen there is no union.

Margin of the Umbrella.—Some of the velar lobes are about as long as broad, somewhat quadrangular in shape, with rounded corners, and some are narrow and more pointed. There are about eight velar lobes between every two ocular lobes.

Sense-organs.—Eight sense-organs are present. The outer sensory pit is triangular in outline and its surface is folded. The principal folds radiate outwards from the bottom of the pit. The tentaculocyst is apparently without an ocellus, as there is no trace of any pigment. The ocular lobes are much smaller than the velar lobes, and are pointed.

Sub-umbrella Muscles.—In one specimen the sub-umbrella muscles have become detached and a clear view of the canal system is obtained. In the other specimen the muscles are present, and they form a circular band between the periphery of the oral disc and the margin of the umbrella. The circular muscle band is continuous and is not radially interrupted.

Sub-genital Cavity.—The four sub-genital ostia open into a common continuous cavity. The ostia are very large, forming long but narrow slits, about 20 millims. in width, and about as wide as the columns. The entrance is partly blocked in the centre by a large triangular gelatinous knob on the sub-umbrella, and just inside there is another median knob and also two small lateral ones.

Oral Arms.—In a normal specimen there should be eight oral arms of equal length, but in both of these specimens the oral arms are abnormal in number and in length. One specimen has ten oral arms, the four columns bearing respectively 2.2.3.3. arms. The arms show a great difference in size, the largest is about 80 millims., and the smallest about 25 millims. As one arm is much longer than the others, which are all of different lengths, it is probable that the medusa received an injury in the oral arms, and regeneration has followed. The upper arm is very short and is somewhat laterally compressed. In the arm, measuring 80 millims. in length, the upper arm is about 15 millims. and the lower arm about 65 millims. The lower arm has three thin wings bearing oral mouths along the outer edges down to the distal end, which does not bear a gelatinous knob. The oral mouths on the ventral wings are continued along the upper arms to the oral disc, where they meet and form a cross-shaped pattern. There are no special appendages of any kind upon the arms or the oral disc. In the second specimen the arms are broken off close to the arm disc and there are stumps of nine, possibly ten, arms.

Stomach.—The stomach is cross-shaped. The gastric filaments run round the margin of the stomach and also curve downwards and inwards, forming a loop in the base of the columns. It is at the end of the loop that the canal from the oral arm enters the stomach.

The gonads are immature.

The specimens are of a whitish colour in formalin.

So far as I can make out, these specimens belong to the genus *Crambessa*, but I am not able to determine the species. As they are immature they are probably at an intermediate stage in growth and may develop into a species which has already been described.

CTENOPHORA.

Order: CYDIPPIDEA, Lesson.

Family: PLEUROBRACHIIDÆ, Chun, 1880.

Pleurobrachia, Fleming, 1822.

Pleurobrachia globosa, Moser, var. **ceylonensis**, nov.

Pleurobrachia globosa, Moser (1903, p. 7, taf. i., figs. 1–4).

The collection contains about 900 specimens, varying in size from about 2 millims. up to 8 millims. in length. The largest specimen measures 8 millims. in length and 7 millims. in width.

A few are preserved in formalin and these have been used for examination, as they have retained their shape better than those in alcohol. The specimens in alcohol suffer more or less from contraction and shrinkage. When contraction or shrinkage is considerable, the position of the various organs changes so much that it would be quite possible to make two or more species out of a hundred specimens.

Locality :—A few were obtained on the Cheval Paar in March and Modragam Paar in November; the great majority were from Galle Bay in June, July and August.

Description.—The body is egg-shaped, sloping towards the oral pole, and almost circular in a transverse section. There are eight rows (costæ) of ciliated plates, of moderate length, extending over half, or a little more than half, of the meridional surface, beginning and terminating at about equal distances from the aboral and oral poles respectively. Each row contains about twenty narrow ciliated plates (combs). The meridional canals are just as long as the costæ. The two tentacles and their sheaths lie above the level of the stomach. The base of the sheath is in the first fork of the gastrovascular canals, on a level with the funnel. The sheath is like a long cone, tapering from the base, and lying at an angle of about 45 degrees from the perpendicular axis of the body and pointing towards the aboral end of the body. The opening of the sheath on the surface of the body is just under the aboral boundary line of the costæ. At the bottom of the sheath is the base of the tentacle, which is somewhat concave. The tentacles have lateral filaments, but no eolidiform appendages were seen. The transverse canals from the funnel to the meridional canals slope slightly in the aboral direction and join the meridional canals in the middle of their length, slightly above the level of the funnel. The base of the tentacle lies a little way from the funnel, but in a large number of specimens, owing to contraction or shrinkage, the base of the tentacle is adjacent to the funnel. It has contracted back on to the funnel and the top of the stomach.

On comparing the specimens with the figures of *Pleurobrachia globosa* (Moser, 1903, taf. i., figs. 1–3), I find that they differ mainly in the length of the costæ, which

are about half as long again. There is a slight difference in the shape of the body, the specimens from Ceylon taper more towards the oral pole. The position of the tentacular sheath is identical and so also is its sheath opening. As the chief difference lies in the length of the costæ, I hesitate to add a new species to the genus, but prefer to mark the difference by establishing a new variety.

The "Siboga" specimens were obtained in the Malay Archipelago.

Order: BEROIDEA, Lesson.

Family: BEROIDÆ, Eschscholtz, 1829.

Beroe, P. Browne, 1756.

Beroe flemingi (Eschscholtz), 1829.

Pandora flemingii, Eschscholtz (1829, p. 39, taf. ii., fig. 7).
Beroe pandora, Moser (1903, p. 23, taf. ii., figs. 8 and 9; taf. iii., figs. 9 and 10).

There are about a dozen specimens in the collection, four of which are in fair condition and the others in fragments.

Description.—The body is conical, compressed in the funnel (transverse) plane, a little longer than wide, and rounded at the aboral end. The mouth is wide and has a fairly thin margin. The costæ are of unequal length; the sub-transversal costæ are about twice or nearly twice as long as the sub-ventral costæ. The meridional canals do not unite with the stomodæal canals. The lateral canals of the meridional canals meander without uniting in the smaller specimens, while in the larger specimens they unite with those from the adjacent meridional canals, forming a coarse irregular network in the outer wall of the body. Short blind canals also proceed from the circular canal around the mouth. The meridional canals on their outer surface are sparsely sprinkled with minute reddish-brown spots of pigment. The gonads are along the walls of the meridional canals, male and female on opposite sides of the canals.

Size:—8 millims. long and 6 millims. wide, 10 millims. long and 10 millims. wide, 12 millims. long and 8 millims. wide. Larger specimens broken into fragments.

Locality:—Off Mutwal Island, March 19, twelve specimens; Galle Bay, July 15, one specimen.

Distribution:—N. Pacific, east of Japan. Malay Archipelago.

Miss Moser, in her 'Report on the Ctenophora of the "Siboga" Expedition,' has revised the Pleurobrachiidæ and Beroidæ, and has given a useful key for the identification of the species. I have tried to identify these specimens with the aid of the key, but remain somewhat doubtful about the result. The difficulty of the identification is no doubt increased by my want of experience in the group and by the fact that the best specimens are early stages. Taking the unequal length of the costæ and the absence

of cilia round the mouth as a guide, the specimens come nearest to *Beroe flemingii*. They do not, however, quite agree in shape, and the lateral canals from the meridional canals do not communicate with the stomodæal canals. Miss MOSER states that the Siboga specimens are identical with *Pandora flemingii* of ESCHSCHOLTZ. This species ESCHSCHOLTZ named after the English zoologist JOHN FLEMING. Miss MOSER, however, has changed the specific name to *pandora*, wishing to retain the generic name *Pandora* as a specific name in honour of ESCHSCHOLTZ. The changing of the specific name of this species is certainly contrary to the International Rules on Nomenclature, and consequently the specific name *pandora* is invalid.

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DESCRIPTION OF PLATES.

All the figures were drawn from specimens in formalin or alcohol; all sense-organs and sections were drawn with a camera lucida.

REFERENCE LETTERS.

A. Adhesive disc.
B. Basal bulb.
CC. Circular canal.
Ec. Ectoderm
En. Endoderm.
Ex. Ex-umbrella.
G. Gonad.
M. Mesoglœa.
N. Nematocyst.
Oc. Ocellus.
Ov. Ovum.
Or. Oral lip.
P. Peronium.
PG. Peronial groove.
R. Radial canal.
S. Sense-organ.
Sm. Septum.
St. Stomach.
Stp. Stomach (gastric) pouch.
Sub. Sub-umbrella.
T. Tentacle.
V. Velum.

PLATE I.

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„ 12. *Cytæis herdmani*, n. sp. Transverse section of a tentacle, showing the nematocysts in the ectoderm and the pigment granules in the endoderm. × 40.

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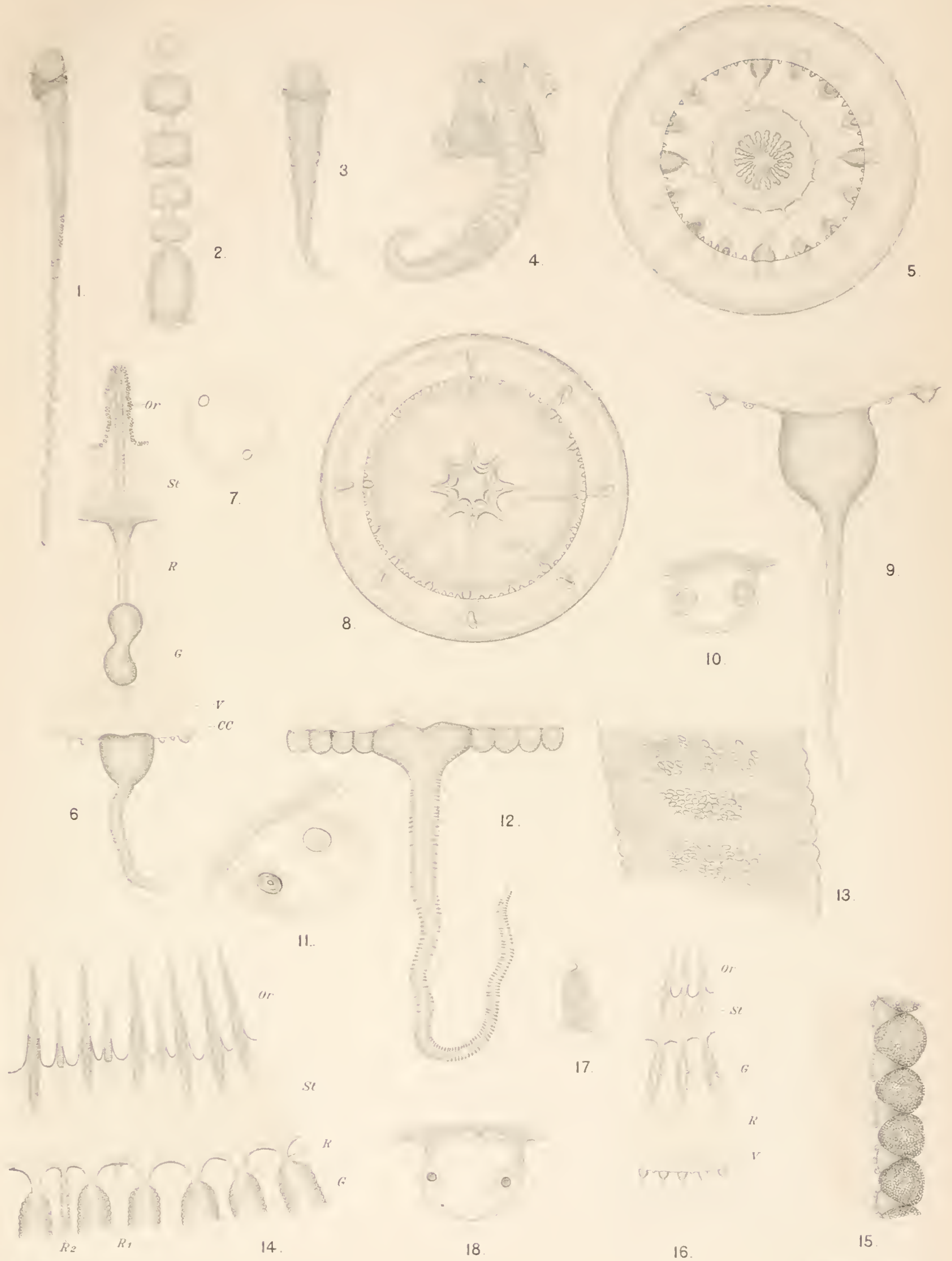
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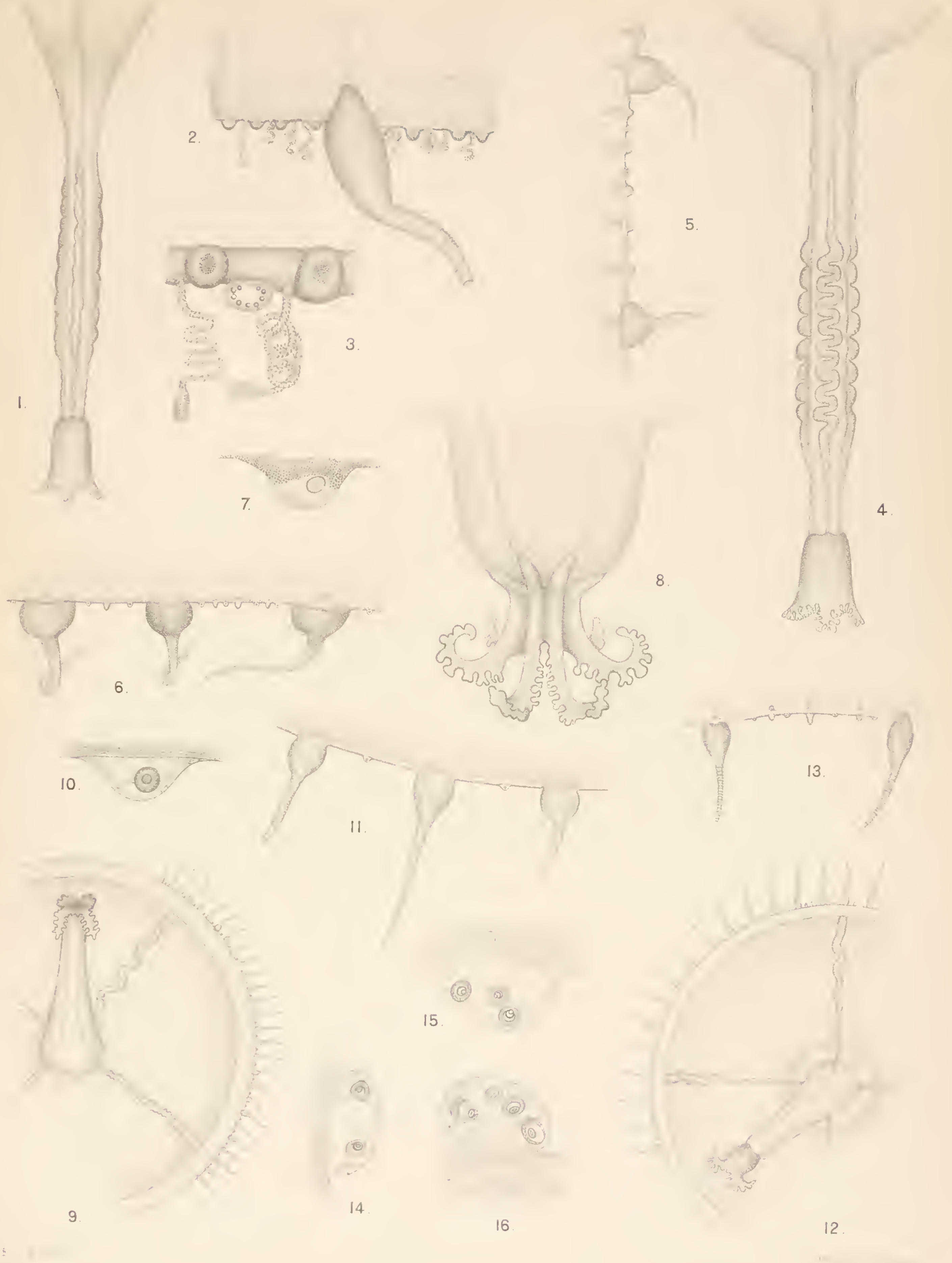
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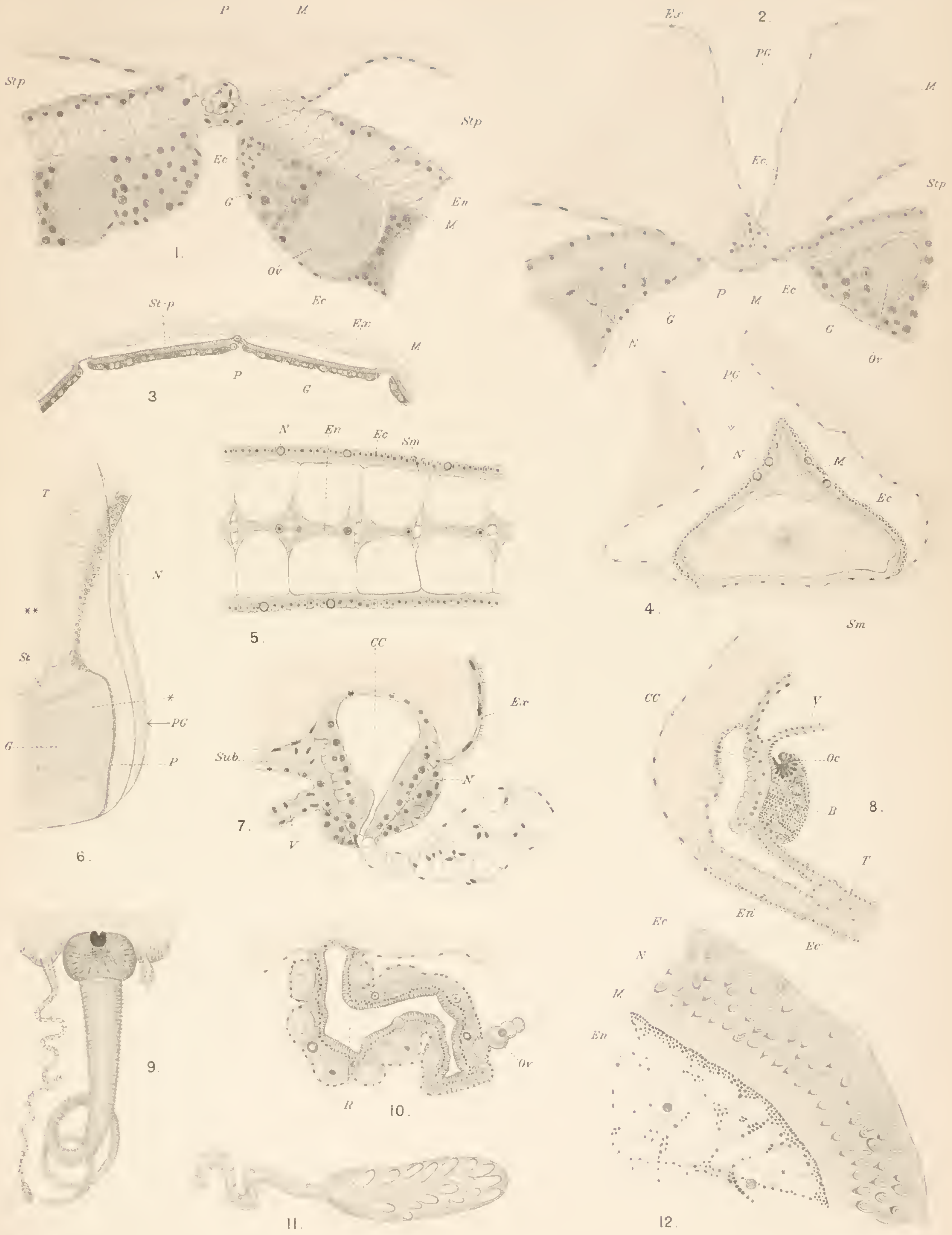
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APPENDIX TO THE REPORT

ON THE

ALCYONARIA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

PROFESSOR J. ARTHUR THOMSON, M.A., UNIVERSITY OF ABERDEEN.

[WITH ONE PLATE AND TWO TEXT-FIGURES.]

A REVISION of the collection of Ceylonese Alcyonarians has enabled me to add to the list given in Supplementary Report No. XX., by Mr. W. D. HENDERSON and myself.*

The additions are:—

Spongodes cervicornis, WRIGHT and STUDER.
,, *involuta*, KÜKENTHAL.
,, *pütteri*, KÜKENTHAL.
,, *microspiculata*, PÜTTER.
,, ,, var. *ceylonensis*, nov.
Chironephthya indica, n. sp.
Suberogorgia köllikeri, WRIGHT and STUDER, var. *ceylonensis*, nov.
,, *rubra*, n. sp.
Caligorgia versluysi, n. sp.
Bebryce indica, n. sp.
Acamptogorgia gracilis, n. sp.
,, *rubra*, n. sp.
Muricella rubra, n. sp.
Virgularia elegans, GRAY.
,, *calycina*, n. sp.
,, *indica*, n. sp.
Fusticularia herdmani, n. gen. et sp., SIMPSON.

One of these (*Caligorgia versluysi*) is hardly an addition, since it replaces *Primnoa ellisii*, VON KOCH (= *Caligorgia ellisii*, = *C. verticillata*). For this correction I have to thank Dr. J. VERSLUYS, Amsterdam. The last on the list, *Fusticularia herdmani*, represents an interesting new genus, which has been separately described by Mr. J. J. SIMPSON, M.A. ('Annals and Magazine of Natural History,' June, 1905).

* By an oversight the two species of *Xenia* (Part III., pp. 271, 273) were misplaced; they should come first in the order Alcyonacea. On p. 289, the title of the family Muriceidæ was omitted in front of *Acanthogorgia*.

FAMILY: NEPHTHYIDÆ.

Spongodes cervicornis, WRIGHT and STUDER.

A much weathered specimen, expanded in one plane, 10·5 centims. in height, by 10 centims. in breadth, and 1·8 centims. in thickness. The general colour is yellowish-white, but the polyp stalks and the polyps are covered with orange-red spicules. The polyps themselves are white in colour, but there appear to be minute orange-red spicules on the tentacles.

The polyp stalk is about 2 millims. in length and is covered by longitudinally disposed spicules. At the base of the polyp, which stands at right angles to the Stützbündel, there is a double ring of transverse spicules, from which there arise eight converging triangles, each composed of two pairs of spicules, the basal pair converging at an obtuse angle.

As the colony is markedly flattened, with an irregular outline, with leaf-like lowermost branches, the specimen must be referred to KÜKENTHAL'S *cervicornis* group, and among those species in which the polyps have long stalks.

The specimen agrees, on the whole, with *Sp. cervicornis*, WRIGHT and STUDER, which seems to be a very variable species, including, according to KÜKENTHAL, *Spongodes rhodosticta*, WRIGHT and STUDER.

Locality:—Ceylon seas.

Spongodes involuta, KÜKENTHAL.

A beautiful divaricate colony, without the stalk, but otherwise almost complete. The general surface of the cœnenchyma is white, near the polyps the colour is strengthened by golden-yellow spicules; the spicules supporting the white polyps are deep rose-pink. The dimensions of height, maximum breadth and average thickness are 45, 40, and 12 millims. As the divaricate polyparium has no regular outline and is markedly flattened, the specimen is referable to KÜKENTHAL'S *cervicornis* group. As the polyps are borne on stalks 1·5 millims. to 2 millims. in length, the specimen must be included near *Sp. cervicornis*, WRIGHT and STUDER. The eight double rows of polyp spicules consist of five pairs of spindles, and thus our attention may be restricted to KÜKENTHAL'S *Dendronephthya involuta*.*

Our specimen agrees with this species in the following features:—(1) there are five pairs of polyp spicules in each double row; (2) one of the uppermost in each row projects above the polyp; (3) the polyp stalk is about 2 millims. in length.

Locality:—Ceylon seas.

Spongodes pütteri, KÜKENTHAL.

A divaricate form, with a regular outline, a slightly flattened polyparium, and

* KÜKENTHAL has referred all typical *Spongodes* species to his new genus *Dendronephthya*, but we see little advantage in this.

foliate lower branches, is referable to KÜKENTHAL'S *rigida* group, and closely approaches *Sp. pütteri.* Thus the polyparium is a slightly flattened cylinder; the lateral branches are almost cylindrical and sometimes dichotomous; the groups of polyps, usually seven in number, are borne by stalks about 2 millims. to 3 millims. in length; the polyps are supported by eight pairs of converging spicules, one of which projects farther than the others; the longest Stützbündel spicule exceeds 3 millims., is covered with minute thorns, and projects for a little over a millimetre. The spicules closely resemble those of *Sp. pütteri* in form and size, but are of a bright orange colour around the polyps and on the polyp stalks. It seems warrantable to regard this specimen as a colour variety of *Sp. pütteri.*

Locality:—Ceylon seas.

Spongodes microspiculata, PÜTTER.

This species is represented by a very beautiful small colony,—6·5 centims. in height and 5·5 centims. in maximum breadth. The stalk by which it is attached is 2·5 centims. long and 1·3 centims. in diameter. The lower branches are foliaceous, but above this there are three main branches, one central and two lateral, in length 3 centims., 2·5 centims., and 2 centims. respectively, with an average diameter of 0·8 centim. From these, smaller branches arise on all sides almost perpendicularly, the lateral ones being the longest, so that the whole colony presents a somewhat flattened appearance, the tips so arranged that the contour is regular. The general colour of the colony is orange-red.

The polyps are in clusters of five to eight, seven being the most typical number. They arise from tertiary branches, except on the lower foliaceous part, which is the expanded portion of primary branches. The polyps are almost globular, standing at right angles to a short stalk 1 millim. in length. The Stützbündel is fairly well developed, one long spindle projecting about 0·8 millim. beyond the insertion of the polyp. On the outside of the anthocodia the spicules have a very definite arrangement, consisting of eight double rows of 6 to 7 converging pale yellow spicules, the terminal pairs projecting a little beyond the anthocodia. Between these groups small colourless spindles are scattered irregularly. On the tentacles the spicules are arranged in a biserial manner, approximately at right angles to the long axis.

The spicules are warty spindles of very varied proportions, some long and slender, others short and thick. On the main stem they are of the second type, the following being typical measurements:—1·2 millims. × 0·5 millim.; 1·3 millims. × 0·4 millim.; 2 millims. × 0·4 millim. On the secondary branches they become more elongated and slender, and have a slight yellow tinge. Further up the colour becomes more marked and there is a distinct orange-coloured core. The following measurements were taken:—2·5 millims. × 0·1 millim.; 1·9 millims. × 0·1 millim. Scattered irregularly amongst these there are small elongated thin spindles of a bright red

colour of the following sizes :—0·3 millim. × 0·02 millim. ; 0·35 millim. × 0·02 millim. The spicules of the polyps are very minute and are pale yellow or colourless, 0·15 millim. × 0·01 millim.

Locality :—Ceylon seas.

Spongodes microspiculata, var. **ceylonensis,** nov.

Another colony, 8·5 centims. high and 5 centims. broad, belongs to the same species, but as it differs markedly in general form and colour it seems advisable to record a distinct variety. The chief points of difference are :—

(1) It does not extend so markedly in one plane, one of the branches arising more or less at right angles to the plane of expansion ;

(2) The general contour is more rugged ;

(3) The colour approaches purple, even on the main branches, owing to the presence of faintly purplish spicules ;

(4) The spicules are arranged on the main stem and branches more transversely ;

(5) The spicules are long, slender, warty spindles, with a light purple tint in the older parts, becoming darker on the smaller branches which bear the polyps. Those of the polyps are transparent and colourless. Measurements :—On the main stem, 2·2 millims. × 0·2 millim. and 1·2 millims. × 0·2 millim. ; on the smaller branches, 1·4 millims. × 0·1 millim., 1·5 millims. × 0·1 millim. ; around the polyps, 0·6 millim. × 0·01 millim.

The architecture of the polyps is essentially the same as in the former specimen, so that this form must be classed in the species *microspiculata*, though the characters enumerated above justify its position as a new variety.

Locality :—Ceylon seas.

FAMILY : SIPHONOGORGIIDÆ.

Chironephthya indica, n. sp.—Plate, figs. 1 and 14.

A specimen of a reddish-brown colour, consisting of two small branches, about 4 centims. in height and 4 millims. in thickness.

The polyps occur on all sides and a frequent interval is 1 millim. Each is about 0·5 millim. in diameter. The anthocodiæ are almost without exception nearly flush with the general surface of the branch.

The opercular covering consists of eight triangular portions or "points" converging over the tentacles, and at the bases of the triangles there are numerous (5) rows of horizontal spicules forming a circlet or "crown." Each triangular "point" consists of three diverging pairs of spicules arranged *en chevron*, the two outermost enclosing the

others. The spicules of the "points" and of the "crown" are reddish-brown to orange-red in colour.

The whole cœnenchyma is covered with large rough spindles, mostly curved in a slightly S-shaped manner, some reddish-brown and others very light in colour. Similar internal spicules constitute the rigid substance of the branch around the longitudinal canals, of which four were seen in a cross-section. The knobbed tubercles often present a spiral arrangement.

The following measurements were taken in millimetres :—(*a*) Long stout spindles, 2·3 × 0·2, 2·5 × 0·175, 2·7 × 0·3 ; (*b*) slender smaller spindles, 1·1 × 0·03, 1·3 × 0·04, 1·5 × 0·025 ; (*c*) very small spindles, 0·2 × 0·025 ; (*d*) canal-wall spicules, uncoloured, with relatively long spines, 0·2 × 0·01, 0·16 × 0·01, 0·14 × 0·02, including the spines.

It seems difficult at present to distinguish between the genera *Chironephthya* and *Siphonogorgia*, if indeed they are not one. HICKSON has suggested that the name *Chironephthya* be retained for species or facies with a form and mode of branching like *Nephthya*, with anthocodiæ rarely retracted, and with four principal spicules *en chevron* in the points of the anthocodiæ ; and that the name *Siphonogorgia* be retained for species or facies of more massive *Gorgonia*-like form of growth, with anthocodiæ capable of complete retraction within the general cœnenchyma, and with spicules irregularly placed or arranged in a fan-like manner in the points of the anthocodiæ ('Alcyonaria of the Maldives,' Part I., p. 491).

If we apply these distinctions to the present specimen, we find that it agrees with *Chironephthya* in having triangular opercular coverings, but disagrees in having almost all the anthocodiæ completely retracted, and in having, as far as we can judge, a more massive mode of growth. As the minute architecture of the polyps is probably the most distinctive feature, we have referred the specimen to *Chironephthya*.

Locality :—Ceylon seas.

FAMILY: SCLEROGORGIIDÆ.

Suberogorgia köllikeri, WRIGHT and STUDER, var. **ceylonensis**, nov.

Several fragments, including a basal piece, of a yellowish colony or colonies with a sclerogorgic axis. The stem is 3 millims. in diameter at the base, and 1 millim. in the thinnest branch of the chief specimen. The greatest length is 8·5 centims.

Verrucæ may arise on all sides, but they are, for the most part, lateral. In the smaller fragments they are altogether lateral and regularly alternate. Their diameter is about 1 millim. Here and there the aperture shows an eight-rayed figure in the fully retracted state of the polyp.

The thin cœnenchyma is marked on opposite sides by two shallow winding grooves.

The spicules include the following forms :—(*a*) Numerous warty spindles, 0·175 millim. × 0·075 millim., 0·225 millim. × 0·075 millim ; (*b*) a few very slender

spindles, 0·1 millim. × 0·02 millim.; (*c*) almost orbicular forms, 0·1 millim. × 0·1 millim.; and (*d*) small spindles (0·1 millim. × 0·03 millim.) on the aboral surface of the tentacles, forming in retraction an opercular covering with eight points.

This form closely approaches *S. köllikeri*, WRIGHT and STUDER, but there the verrucæ have a diameter of 2 millims. to 3 millims., the polyps are large and prominent, the verrucæ have eight-rayed margins, and the colour is yellowish-brown. But as the differences are hardly more than quantitative, we rank the Ceylonese specimens simply as a variety of the "Challenger" species.

Locality:—Ceylon seas.

Suberogorgia rubra, n. sp.—Plate, fig. 4.

Half-a-dozen fragments of a red colony, with a sclerogorgic very horny axis (1·5 millims. in diameter), with a nutrient canal on each side, with thin friable cœnenchyma, and with close-set, lateral, alternate verrucæ, about 1 millim. in diameter. The completely retractile polyps are white with a slight yellowish sheen, and are supported by groups of small colourless spicules. It is difficult to make out with certainty what the precise arrangement of these spicules is, but in two or three cases eight triangular groups were seen on the polyp wall. In the fully retracted state of the polyps the verruca appears as a rounded hillock beset with somewhat blunt spindles.

The spicules of the cœnenchyma are warty spindles of very varied dimensions. The following measurements were taken in millimetres:—(*a*) yellow spindles, 0·45 × 0·1, 0·3 × 0·1; (*b*) colourless spindles, 0·175 × 0·07, 0·2 × 0·08.

The colour when first examined was a bright red, but it has since become paler and shows a tint of orange. We note this change because it is unusual in Alcyonarians.

The fragments in question most closely approach *S. köllikeri*, WRIGHT and STUDER, var. *ceylonensis*, n., but the polyps are much more crowded and decidedly smaller, and both colour and spiculation are different. One of the fragments bore a very minute pearl oyster.

Locality:—Ceylon seas.

FAMILY: PRIMNOIDÆ.

Caligorgia versluysi, n. sp.—Plate, figs. 6 and 15.

The beautiful form which we recorded (Part III., p. 289) as *Primnoa ellisii*, VON KOCH, appeared to us to agree with the description given by VON KOCH, and so up to a certain point it does. But Dr. J. VERSLUYS has been good enough to point out to me that VON KOCH'S description is not sufficiently minute to enable one to discriminate between *Primnoa* (or better *Caligorgia*) *ellisii* and other species which have since been defined off. Dr. VERSLUYS was kind enough to examine the

specimen from the Ceylonese collection and another from the Indian Museum collection (see Part III., p. 289). He regards them as representatives of two new species, distinct from VON KOCH'S, and closely related to a new species (*C. similis*) which will be described in VERSLUYS' memoir on the Primnoidæ of the "Siboga" Collection. In the "Siboga" material he found that the number and arrangement of the sclerites in the polyps afforded a constant and reliable basis for specific diagnosis.

We have therefore to withdraw the remarks we made on the geographical distribution of *Primnoa ellisii* (= *Caligorgia verticillata*), and we have to record from Ceylon the new species *Caligorgia versluysi*, the particular features of which are discussed in the following note which Dr. VERSLUYS has generously supplied:—

Note by Dr. Versluys.

"I find that the Primnoid collected by Professor HERDMAN at Ceylon is not referable to *Primnoa ellisii*, VON KOCH. As it seems to me that VON KOCH was not justified in separating his species from *Caligorgia verticillata* (PALLAS), I shall use the older name in comparing it with HERDMAN'S species.*

The Ceylonese species is decidedly more delicate than *C. verticillata*, and the type of ramification is different. The more important differences are stated in the following table:—

1. CHARACTERS OF HERDMAN'S SPECIES.	2. CHARACTERS OF *Caligorgia verticillata*.
(*a*) The colony is dichotomously branched.	(*a*) The colony is pinnately branched.
(*b*) The polyps are arranged in whorls of 3 and occasionally of 2; no higher number was observed.	(*b*) On the thinnest twigs the polyps are arranged in whorls of 3, very rarely of 2; on the thicker branches the whorls mostly consist of 4 polyps.
(*c*) On a centimetre of the twigs about 8 whorls of polyps are found.	(*c*) On a centimetre there are only 5 or 6 whorls.
(*d*) The length of the contracted polyps is less than 0·75 millim.	(*d*) The length of the contracted polyps is 1 millim. to 1·25 millims.
(*e*) The distance between two successive whorls generally varies between 0·6 millim. and 0·75 millim.; sometimes, however, it rises up to 1 millim.	(*e*) This distance is 1 millim. to 1·5 millims.

Of the 8 longitudinal rows of scales, which formed the covering of the polyps in the typical primitive Primnoinæ, viz., a pair of adaxial, inner lateral, outer lateral and abaxial rows, only four rows, the abaxial and outer lateral pair, are well developed in both species. The inner lateral rows are each reduced to a single large distal

* Compare VERSLUYS, 'Primnoidæ; "Siboga" Expeditie, Monograph XIII,' second part, which is in the press.

scale in Herdman's species, against two large distal scales in *C. verticillata.* The outer lateral rows are somewhat reduced in Herdman's species, as they number only 5 scales, against 7 (or 6 if the most basal scale is considered as belonging to the cœnenchyma) in *C. verticillata.* The abaxial rows in this last species consist of 9 scales each, all of nearly the same rounded form, and not extending over the sides of the polyps, which are entirely covered by the scales of the well-developed outer lateral rows. In Herdman's species the abaxial rows are formed by 10 or 11 scales of rather diverse form, as 2 or 3 are somewhat prolonged laterally over the sides of the polyps between the scales of the somewhat reduced outer lateral rows. The upper margin of the polyp scales in Herdman's species is not strongly toothed, but these teeth are well developed and more numerous in *C. verticillata.* In this last species the operculum forms a higher and, consequently, more pointed cone on the top of the polyp. The scales in the cœnenchyma are of the same type, polygonal scales with strongly toothed irregular borders, and with the outer surface covered with radiating and anastomosing prominences.

The species collected by Professor Herdman may also be easily distinguished from all the previously described dichotomously branched species of *Caligorgia*, viz., *C. ventilabrum*, *modesta* and *compressa.** It is more delicate, with smaller polyps, and none of these three species has so few polyps in each whorl, even on its thinnest twigs.

There are, however, two new species in the collection made by the "Siboga" Expedition in the Malay Archipelago, which in their habit, the dimensions of their polyps, and the small number of polyps in each whorl very closely resemble Herdman's species. They will be described in my paper on the Primnoidæ of the "Siboga" Expedition; in this note I can only point out the more important differences between these two species and Herdman's.

One of them, *C. minuta*, is easily distinguished by the much less numerous and proportionately much larger scales in its polyps. The abaxial rows consist of only 5 scales, of which the 4 proximal ones extend over the sides of the polyps, where they replace the outer lateral rows, of which only one large distal scale in the upper margin of the polyps is left.

The other new form, *C. similis*, is more closely allied to Herdman's species. But while its polyps are arranged in whorls of 3, very rarely 2, on the thinnest twigs, on the thicker branches the whorls number 4, perhaps even sometimes 5 polyps. On one centimetre length of the twigs the same number of whorls (8) is found. But the polyps are somewhat larger, measuring from 0·75 millim. to 0·8 millim. in length, sometimes even 1 millim., against 0·75 millim. or less in Herdman's species, and consequently the distance of the successive whorls is on an average somewhat less. The most important differences, however, are found in the polyps; they are shown in the following table:—

* *C. elegans*, Gray, is insufficiently described and a doubtful species.

1. Polyps of Herdman's Species.	2. Polyps of *Caligorgia similis.*
(*a*) The abaxial rows are formed by 10 (or 11) scales each.	(*a*) The abaxial rows are formed by 7 scales.
(*b*) The outer lateral rows are but little reduced, consisting of 5 scales each.	(*b*) Of the outer lateral rows only one large distal scale is left.
(*c*) When the polyps are seen from the side, the distal scale of the inner lateral row is clearly visible.	(*c*) No scale of the inner lateral row is visible when the polyps are seen from the side.
(*d*) The abaxial scales show no well-developed extensions over the sides of the polyps, though such an extension is clearly indicated in some of them.	(*d*) The 5 proximal abaxial scales are produced laterally and replace the missing outer lateral scales.
(*e*) The outer surface of the scales of the polyps is covered with prominences radiating from the nucleus and partly ending in teeth at the upper border of the scales.	(*e*) No prominences are developed; the teeth are few and feeble.

In both species the outer surface of the scales of the cœnenchyma is covered with anastomosing prominences, many of which end in a tooth at the border of the scales. These prominences give a typical appearance to the scales of the cœnenchyma; they are more strongly developed in Herdman's species than in *C. similis.* They are also found in some pinnately branched species of *Caligorgia*, for instance, *C. verticillata* and *C. sertosa.*

From this comparison it may be concluded that the *Caligorgia* in the collection made by Professor Herdman is a new species, recognisable by its dichotomous ramification, its delicate habit, the small number of polyps in each whorl, its very small polyps, and by the comparatively large number of scales covering the polyps.

I have to thank Professor Herdman and Professor J. Arthur Thomson for their kindness in sending me some material to study this species. In many respects it resembles *C. verticillata.* The description given of this last species under the name *Primnoa ellisii*, by von Koch, though excellent and valuable in many respects, does not give many morphological details, especially in regard to the arrangement and form of the scales in the polyps. A renewed investigation was necessary to make out how far it is different from Herdman's specimen. This investigation has shown conclusively that the two are different species, but it is readily comprehensible that Professor Thomson was led by von Koch's description to consider the species as identical."

Locality:—Deep water off Galle.

Family: MURICEIDÆ.

Bebryce indica, n. sp.—Plate, fig. 3.

The collection included several specimens of a Muriceid, which we have, with some hesitation, referred to the genus *Bebryce.* It agrees with this genus in its general features, but differs considerably in its spiculation from *B. mollis*, von Koch,

B. studeri, WHITELEGGE, *B. philippi*, STUDER, and *B. hicksoni* already described by us (Part III., p. 294). In our account of *B. hicksoni* we referred to what might be regarded as varieties of that species, but some additional specimens which we have studied cannot so be dealt with.

All are dark-coloured irregularly branched colonies, disguised by a growth of monaxonial siliceous sponge, and with one exception spreading in one plane. The exception has seven alternate branches, terminally clavate, on an average 2 millims. in diameter, and is 8 centims. in height by the same in maximum breadth. One of the specimens attained a height of 18 centims.

The verrucæ are prominent truncated cones, usually on all sides of the main stem and branches, but sometimes almost restricted to the sides in the plane of branching. They are about 1·5 millims. in height and breadth, and are separated along one line by intervals of 1·5 millims to 2 millims. Except in a few cases, the polyps are completely retracted and the verrucæ are thickly beset with sponge spicules.

The axis is non-calcareous, light brown in colour, very soft and flexible, and traversed by twisted longitudinal grooves whose depth has doubtless been increased by shrinkage of the core. The diameter of the axis is about 1·25 millims.

When the sponge spicules are carefully removed, the surface of the cœnenchyma exhibits the characteristic *Bebryce* appearance. There is a coherent mosaic of interlocked tuberculate discs, and large pieces can be separated off after slight heating without any loosening of the component spicules. The average thickness of the cœnenchyma is about 0·3 millim.

On the few polyps which could be satisfactorily seen, there were relatively large tuberculate spindles.

The following types of spicules occur :—

(*a*) Almost regular tuberculate quadriradiate forms, with more or less pronounced cruciate arms, and sometimes at least with an internal boss at right angles to the expanded disc, 0·15 millim. × 0·125 millim. in length and breadth of the disc.

(*b*) Irregular quadriradiate forms, with the arms to one side longer and stronger than those to the other side; 0·25 millim. between the tips of the longest arms, 0·15 millim. between a long and a short arm, 0·1 millim. between the two short arms.

(*c*) Approximately square forms, suggestive of amphicœlous vertebræ, with slightly prolonged corners and slightly concave sides, 0·175 millim. × 0·175 millim.; and transitional forms connecting these with the pronounced quadriradiate types.

(*d*) Tuberculate "capstans," with a very slightly marked middle zone, separating two equal portions; and a variety of this "double-club" type with the part to one side of the waist much smaller than the other—a feature prominent in the spicules of some other species of this genus; 0·125 millim. × 0·1 millim. in height and breadth.

(*e*) Small tuberculate forms, more like "double wheels" than capstans; 0·1 millim. × 0·1 millim. in length and breadth, and 0·04 millim. across the "waist."

(*f*) Bent, warty spindles from the polyps, including (1) short, thin, rough forms

with relatively long, irregularly disposed tubercles, *e.g.*, 0·35 millim. in length by 0·075 millim. at the broadest part, and (2) longer, smoother forms with relatively shorter, more regular tubercles, 0·5 millim. to 0·6 millim. in length by 0·05 millim. in maximum breadth.

It is unsatisfactory that we have not been able to study the polyps of this species, but there is no doubt that some of the spicules are flattened tuberculate discs with an internal boss, approaching the so-called "scales" of *Bebryce*. If we are right in our diagnosis, *B. indica* is nearest *B. hicksoni*, but there the "scales" were numerous and unmistakable, and quadriradiate or cruciate forms, which are here characteristic, were not seen.

Locality :—West of Periya Paar, Gulf of Manaar.

Acamptogorgia gracilis, n. sp.—Plate, figs. 12 and 13.

A weathered and yet distinctive specimen, 6 centims. in height by 4 centims. in breadth. From a short distance the branches appear pinkish red, and the verrucæ stand out like white papillæ. Closer examination with the lens shows an exquisite mingling of red and colourless spicules, the former producing a somewhat characteristic punctate appearance.

The verrucæ may occur on all sides of the branches, but are for the most part lateral in position; they stand out almost at right angles to a height of about 1 millim. ; they are sometimes opposite, sometimes alternate, and the branch terminates in a pair.

The cœnenchyma presents a rough surface owing to the projecting sharp points of the continuous layer of spicules. The characteristic spicules of the cœnenchyma are continued without marked change up the sides of the verrucæ, the projecting tips being all directed upwards. At the top of the verruca there is a ring of horizontal spicules in two rows, and on this is based an opercular covering of eight parts, each composed of two curved foliaceous spindles.

The axis is brown in colour, non-calcareous, 1·5 millims. in diameter at the base, and rather less than 0·5 millim. in the delicate twigs, where it becomes much paler in colour, almost approaching yellow. It shows at places the chambered appearance seen in some other species of this varied genus.

The spicules include the following types :—

(*a*) Curved warty spindles with a bidentate or otherwise toothed foliaceous expansion from the middle of the curve, 0·3 millim. between the tips by 0·1 millim. at the broadest part ;

(*b*) Clubs with irregularly expanded divaricate ends, 0·25 millim. in extreme length by 0·15 millim. at the broadest part ;

(*c*) Small irregularly stellate forms, 0·1 millim. × 0·1 millim. ; and

(*d*) Forms with four or more rays, 0·3 millim. × 0·2 millim.

Locality :—Ceylon seas.

Acamptogorgia rubra, n. sp.—Plate, fig. 5, and text-fig. 1.

A deep crimson, incomplete colony, 5 centims. in height, giving off in one plane three lateral branches which have an average thickness of about 1 millim. There is also a fragment about 2 centims. in length, with four twigs arising almost at right angles from the main branch, which is slightly over 1 millim. in breadth.

Fig. 1.
Acamptogorgia rubra, n. sp. × 15.

The verrucæ, 0·5 millim. in height by 1 millim. in breadth, are alternate or sub-opposite, and arise at right angles to the axis. Two occur side by side at the end of a branch. The cœnenchyma is thin and presents a very prickly appearance, due to the projecting folia and spines of the beautiful crimson spicules. The axis is yellowish, 0·3 millim. to 0·4 millim. in diameter.

The spicules show considerable diversity of form :—

(*a*) Straight, warty spindles, 0·6 millim. × 0·1 millim. ;

(*b*) Narrow, curved spindles, smooth terminally, warty about the middle, 0·6 millim. × 0·05 millim.

(*c*) Large triradiate forms in which the shortest, almost smooth ray projects externally and often bears a foliaceous expansion, while the two larger rays are denticulate or branched to a very varied degree ; 0·6 millim. in breadth between the tips of the longest rays and 0·4 millim. in height between a line joining these internal tips and the tip of the external ray.

(*d*) Smaller and often simpler triradiate forms, 0·45 millim. in breadth and 0·25 millim. in height, and much smaller.

(*e*) Small, very warty spindles with a foliaceous expansion about the middle, 0·2 millim. × 0·1 millim.

Locality :—Ceylon seas.

Muricella complanata, Wright and Studer.

Reference has already been made (Part III., p. 303) to varietal forms of this species, which seem to vary considerably in detail. Another form deserves to be recorded. It differs from the type in the coloration of the spicules, large yellowish spindles covering smaller transparent ones, and others still smaller which are rose-coloured. Thus the rubbed base of the specimen is bright rose, while the upper parts are ochreous yellow—a difference which seems to be wholly due to the degree of abrasion.

The verrucæ show the characteristic longitudinal grouping of small spindles in eight triangles, but it may be noted that in some cases they occur opposite one another, instead of alternately as in the type, and that the diameter of their base can hardly be said to exceed a millimetre, while that in the type was 2 millims.

Muricella rubra, n. sp.—Plate, figs. 2 and 7.

A minute fragment of a bright-red colony with a relatively thin cœnenchyma filled with long warty spindles.

The verrucæ are crowded and alternate, low and subconical, arising at right angles to the surface, and covered with spindles smaller than those of the cœnenchyma. The polyps are white and stand out conspicuously. The axis is light yellow, non-calcareous, flexible, 0·5 millim. in diameter.

The general spicules of the cœnenchyma are (*a*) large warty spindles, straight or slightly **S**-shaped, 1·2 × 0·2, 0·95 × 0·175 millims. ; and (*b*) small warty spindles, 0·5 × 0·1, 0·4 × 0·075 millim. In the polyps the spicules are transparent, slightly warty spindles, 0·25 × 0·04, 0·2 × 0·03 millim.

Locality :—Ceylon seas.

Family : VIRGULARIIDÆ.

Virgularia loveni, Kölliker.

We have already recorded the occurrence of representatives of *V. loveni* in this collection, but another specimen has come to hand which deserves notice, especially as that on which Kölliker based his species was very imperfect.

This is also an incomplete specimen, but very well preserved, and presenting several features which make us hesitate in referring it to *V. loveni* unless Kölliker's diagnosis be somewhat modified. It is about 90 millims. in length, 5 millims. to 9 millims. in breadth, and is altogether pinnule-bearing, except 15 millims. at the broken basal part. The lower pinnules are closely crowded without visible intervals ; those on the upper portion are separated on the prorachidial surface by intervals of 1 millim. to 1·5 millims., and overlap on the metarachidial surface. There is a bare tract, 2·5 millims. in breadth, along the prorachidial surface, and up the middle of this there runs a well-marked narrow groove.

The free margin of the pinnule curves like an elongated **S**, and its prorachidial insertion is higher than the other. Most of the pinnules are turned markedly downwards. There were 30 polyps on the pinnules counted, and a single row of zooids extends transversely in the interspace between the pinnules. The polyps are very distinct, but the indentations between the calices are shallow.

The axis, which measures 2·25 millims. in diameter at the base, is cylindrical, whitish, and covered with remarkable indentations and irregular ridges.

This form agrees with *V. loveni* in having up to 30 polyps on the pinnules, an indented ridged axis, the zooids in a single row, and so on ; but in Kölliker's specimen the pinnules were 3 millims. to 4 millims. apart, the shape was approximately fan-like, and the calices were scarcely distinct.

Locality :—Ceylon seas.

Virgularia elegans, Gray.

To this imperfectly described species we refer an imperfect specimen, and if the reference be correct we can make Gray's diagnosis a little more definite.

The rachis bears 106 pairs of pinnules; it is 145 millims. in length, including 15 millims. of exposed axis at the broken basal end; its breadth is 2 millims. to 3 millims., and that of the axis 1·25 millims.

The pinnules have a breadth and height of 2·75 millims. × 0·5 millim., 2·75 millims. × 2 millims., 2·25 millims. × 0·75 millim., at the base, middle portion, and top of the rachis. The interval between them is 0·25 millim. at the base and 2 millims. at the top. They bear 18 polyps in a single row.

Locality :—Ceylon seas.

Virgularia calycina, n. sp.—Plate, figs. 8, 9, 10, 11.

An incomplete specimen, 57 millims. in length by 3 millims. to 4 millims. in breadth, altogether pinnule-bearing, except 5 millims. of bare axis at the broken basal end.

The lower pinnules are closely crowded, with no intervals between them, but in the upper portion of the rachis they become distant, being separated by intervals of 1·75 millims. There is a bare streak, about 0·75 millim. in breadth, along the prorachidial surface.

The pinnules are substantial and distinct, though relatively narrow, and their prorachidial insertion is very markedly higher than the other. The curve of their free margin is a crescent. On each of those counted there were 18 very distinct calices, with conspicuous longitudinal grooves. When the polyps are retracted, the calices are ovoid in shape, about 1 millim. in height, with a minute circular aperture. The polyps appear to be arranged, except the first three or four at the prorachidial side, in two alternating rows, but this is simply due to the fact that they are alternately shunted to opposite sides along the margin of the pinnule. The inferior surface of the pinnule is strongly marked by eighteen parallel ridges, each corresponding to a calyx or polyp. On the upper surface there are similar markings, but less pronounced. Some of the polyps contain ova. Here and there a few minute lateral zooids were seen in a row about halfway between two pinnules.

The axis is white and cylindrical, with somewhat delicate and complex markings.

This form should be ranked among those species of *Virgularia* which Kölliker described as having distinct pinnules, distinct calices, zooids in one row or in two rows, with the ventral insertion higher than the dorsal, with non-transparent, crescent-shaped pinnules,—that is to the artificial section including *V. mirabilis* (O. F. Müller) (with 6 to 9 polyps), *V. multiflora*, Kner (with 11 to 15 polyps), and some uncertain forms. But from *V. multiflora* this new form is at once distinguishable by the markedly separate calices, and also by their number, &c. In *V. juncea*, again, the pinnules are very slight, and the calices are not separate; in

V. reinwardtii there are 18 polyps, but the calices are not separate. The present specimen appears to be nearest *V. elegans*, GRAY, but in that species the pinnules are much less distinct, the number of calices is 14 to 24, and the calices are "scarcely separate at the margin."

Locality :—Ceylon seas.

Virgularia indica, n. sp.

Several incomplete specimens, about 12 centims. in length by 5 millims. to 6 millims. in breadth, bearing over 120 pairs of pinnules. About a fourth of these are well developed and are separated by intervals of 0·75 millim. On the upper region of the prorachidial surface there is a bare streak 2 millims. in breadth, which becomes a narrow line in the lower half of the colony. On the lower half of the metarachidial surface there is a deep channel left up the middle between the two rows of pinnules, but higher up this is lost, since the opposite pinnules meet or regularly overlap. There were 15 polyps on all the pinnules counted and the siphonozooids occur in equal number in a row midway between two pinnules or near the base of the upper pinnule. The ovoid calices are distinctly marked off from one another and the translucent pinnule shows grooves and ridges corresponding in number to the polyps. Several ova were seen in the pinnules.

The axis is cylindrical, about 1 millim. in diameter, and covered by a reddish-brown investment. As regards the number of polyps on a pinnule, this form resembles *V. multiflora*, KNER, which JUNGERSEN regards as merely a variety of *V. mirabilis* (O. F. MÜLLER). But the pinnules are much closer together, they often show an S-shaped curve, and they are translucent; the calices are distinctly separated from one another; the axis is flexible and covered with a reddish investment.

It therefore seems necessary to establish a new species.

Locality :—Modragam Paar, Gulf of Manaar.

It may seem remarkable that Professor HERDMAN should have found in a short time within a limited area no fewer than six species of *Virgularia*. This is the more extraordinary since the rich collection of deep-water Alcyonarians made by the "Investigator" in the Indian Ocean does not include a single representative of the genus.

It seems extraordinary, almost suspicious, that the handful of *Virgulariæ* before us should include three new species, in spite of our endeavours to unite these with others previously described. We would therefore note that :—

(1) *V. tuberculata* is conspicuously characterised by its red tuberculated axis and by the six, relatively large, very distinct, barrel-shaped polyps on each small pinnule;

(2) *V. calycina* is conspicuously characterised by its 18 very distinct ovoid calices on each prominently ridged pinnule;

(3) *V. indica* approaches *V. multiflora*, but differs in having the pinnules much

closer, often S-shaped, translucent, with distinctly separated calices, and in other characters.

FAMILY: CAVERNULARIIDÆ.

Fusticularia herdmani, SIMPSON—Plate, figs. 16 to 22, and text-fig. 2.

I entrusted to Mr. J. J. SIMPSON, M.A., my private assistant, a small club-like specimen which had been overlooked in the first study of Professor HERDMAN'S collection. It had, indeed, so much resemblance to a corticate sponge that it was originally sent for examination to Professor DENDY. The accompanying text-figure (fig. 2) is a reproduction of a drawing of the colony made by Professor DENDY.

Fig. 2. *Fusticularia herdmani*, SIMPSON. × 2.

Mr. SIMPSON has published an account of this interesting form in the 'Annals and Magazine of Natural History,' xv. (1905), pp. 561–5, 1 plate, and has named it appropriately *Fusticularia herdmani*, gen. et sp. n.

The specimen is a small free-living sponge-like colony, 3·7 centims. in length, 1·7 centims. in breadth, and 1 centim. thick. It consists of a flattened ovoid stock separated by a constriction from a comparatively slender trunk 1·2 centims. long and 0·6 centim. in breadth.

The general colour is a dark brown, approaching chocolate.

The zooids are dimorphic, the smaller siphonozooids being scattered irregularly among the larger autozooids, which are separated by distances varying from 1 millim. to 3 millims. The zooids are completely retractile into pit-like depressions, about 0·5 millim. in diameter. The length of a fully expanded autozooid is about 0·75 millim. to 1 millim. and the tentacles measure 0·7 millim.

Three longitudinal canals traverse the colony throughout its entire length.

The cœnenchyma is densely spiculose. The spicules, which vary greatly in form and size in the different parts of the colony, are arranged in bundles supporting the polyp cavities. All are hyaline and smooth and the majority bear blunt digitiform terminations which are often marked by characteristic annulations. The most frequent types are the following: blunt spindles, cylinders, clubs, double barrels and palmate forms. They vary in size from 0·3 × 0·05 millim. in the cortical layer of the stock to 0·45 × 0·025 millim. in the trunk. Among the characteristic features of this genus the following are most noteworthy: (*a*) the minuteness of the zooids; (*b*) the absence of an axis; (*c*) the broadly palmate spicules; (*d*) the elliptical trunk; (*e*) the constriction between stock and trunk; (*f*) the number (3) of canals in the stock; (*g*) the small number of autozooids.

The diagnosis reads:—"A somewhat sponge-like cavernularid, with a flattened ovoid stock separated by a constriction from a comparatively slender sterile trunk; with dimorphic retractile polyps, the autozooids not exceeding 1 millim. in length, the much smaller siphonozooids scattered irregularly among the autozooids; with abundant densely spiculate cœnenchyma, traversed by three longitudinal central canals passing down into the trunk; with smooth hyaline spicules bearing peculiar digitiform terminal processes and showing very characteristic annulations, especially near the ends."

Locality:—Cheval Paar, Gulf of Manaar, 6 fathoms.

NOTE.—Further inquiry into the history of the specimen listed by Professor HERDMAN and Mr. HORNELL in their diaries as a possible *Corallium* sp. has shown that this tentative identification was mistaken. We therefore withdraw the paragraph referring to this specimen on p. 289 of Part III. of this Report.—J. A. T.

Complete List of the Species of Alcyonaria reported on :—

Order I. : Stolonifera.

Family : Clavulariidæ.

**Clavularia margaritiferæ*, n. sp.

Order II. : Alcyonacea.

Family : Xeniidæ.

Xenia ternatana, Schenck.
,, *umbellata*, Sav.

Family : Alcyoniidæ.

**Bellonella indica*, n. sp.

Family : Nephthyidæ.

Nephthya chabrolii, Aud., var. *ceylonensis*, n.
,, *lobulifera*, Holm.
* ,, *ceylonensis*, n. sp.
**Eunephthya purpurea*, n. sp.
**Paraspongodes striata*, n. sp.
**Capnella manaarensis*, n. sp.
Spongodes bicolor, Wright and Studer.
,, ,, ,, ,, var. *ceylonensis*, n.
,, ,, ,, ,, var. *dubia*, n.
,, *rosea*, Kükenthal.
,, *armata*, Holm., var. *ceylonensis*, n.
,, *dendrophyta*, Wright and Studer.
,, *splendens*, Kükenthal.
,, *cervicornis*, Wright and Studer.
,, *involuta*, Kükenthal.
,, *pütteri*, Kükenthal.
,, *microspiculata*, Pütter.
,, ,, var. *ceylonensis*, n.
* ,, *pulchra*, n. sp.
* ,, *aurantiaca*, n. sp.

Family : Siphonogorgiidæ.

**Paranephthya pratti*, n. sp.
Chironephthya variabilis, Hickson.
* ,, *indica*, n. sp.
Siphonogorgia pustulosa, Wright and Studer.
,, *miniacea*, Kükenthal.
,, *köllikeri*, Wright and Studer.

Order III. : Pseudaxonia.

Family : Briareidæ.

Solenocaulon tortuosum, Gray.

Family : Sclerogorgiidæ.

Keroeides gracilis, Whitelegge.
Suberogorgia verriculata, Esper.
,, *köllikeri*, Wright and Studer, var. *ceylonensis*, n.
* ,, *rubra*, n. sp.

Order IV. : Axifera.

Family : Primnoidæ.

**Caligorgia versluysi*, n. sp.

Family : Muriceidæ.

Acanthogorgia muricata, Verrill, var. *ceylonensis*, n.
* ,, *media*, n. sp.
* ,, *ceylonensis*, n. sp.
**Astromuricea ramosa*, n. sp.
Echinomuricea indo-malaccensis, Ridley.
* ,, *ceylonensis*, n. sp.
Echinogorgia pseudosasappo, Kölliker.
* ,, *multispinosa*, n. sp.
**Heterogorgia verrilli*, n. sp.
**Bebryce hicksoni*, n. sp.
* ,, *indica*, n. sp.
Acamptogorgia spinosa, Hiles.
,, ,, ,, var. *ceylonensis*, n.
* ,, *atra*, n. sp.
* ,, *gracilis*, n. sp.
* ,, *rubra*, n. sp.
Acis orientalis, Ridley.
* ,, *indica*, n. sp.
* ,, *alba*, n. sp.
* ,, *ceylonensis*, n. sp.
,, ,, ,, var. *imbricata*.
Muricella nitida, Verrill.
,, *complanata*, Wright and Studer.
* ,, *ramosa*, n. sp.
* ,, *ceylonensis*, n. sp.
* ,, *rubra*, n. sp.

FAMILY: Plexauridæ.

Plexaura prælonga, var. *typica* (RIDLEY).
,, ,, ,, *elongata*, n.
,, *antipathes*, KLUNZINGER, var. *flexuosa*, n.

FAMILY: Gorgoniidæ.

Lophogorgia lutkeni, WRIGHT and STUDER.
* ,, *rubrotincta*, n. sp.
* ,, *irregularis*, n. sp.
Leptogorgia† *australiensis*, RIDLEY, var. *flavotincta*.
,, ,, ,, ,, *perflava*.
,, (?) sp.
**Stenogorgia ceylonensis*, n. sp.
Gorgonia capensis, HICKSON.
Rhipidogorgia sp.

FAMILY: Gorgonellidæ.

**Scirpearella aurantiaca*, n. sp.
* ,, *divisa*, n. sp.
,, sp. α.
,, sp. β.
,, sp. γ.
Scirpearia sp.
Juncella gemmacea, VALENCIENNES.
,, *juncea*, PALLAS.
,, *fragilis*, RIDLEY.
,, ,, ,, var. *rubra*, n.
* ,, *trilineata*, n. sp.
Verrucella flexuosa, KLUNZINGER, var. *aurantiaca*, n.
,, ,, ,, ,, *gallensis*, n.
* ,, *rubra*, n. sp.

ORDER V.: STELECHOTOKEA

SECTION I.: ASIPHONACEA.

FAMILY: Telestidæ.

Telesto rubra, HICKSON.
,, (*Carijoa*) *trichostemma*, WRIGHT and STUDER.

SECTION II.: PENNATULACEA.

FAMILY: Umbellulidæ.

Umbellula sp.

FAMILY: Virgulariidæ.

Virgularia multiflora, KNER.
,, *loveni*, KÖLLIKER.
,, *elegans*, GRAY.
* ,, *tuberculata*, n. sp.‡
* ,, *calycina*, n. sp.
* ,, *indica*, n. sp.

FAMILY: Pennatulidæ.

Halisceptrum gustavianum, HERKLOTS.
* ,, *periyense*, n. sp.
Pteroeides lacazei, var. *spinosum*, KÖLLIKER.

FAMILY: Veretillidæ.

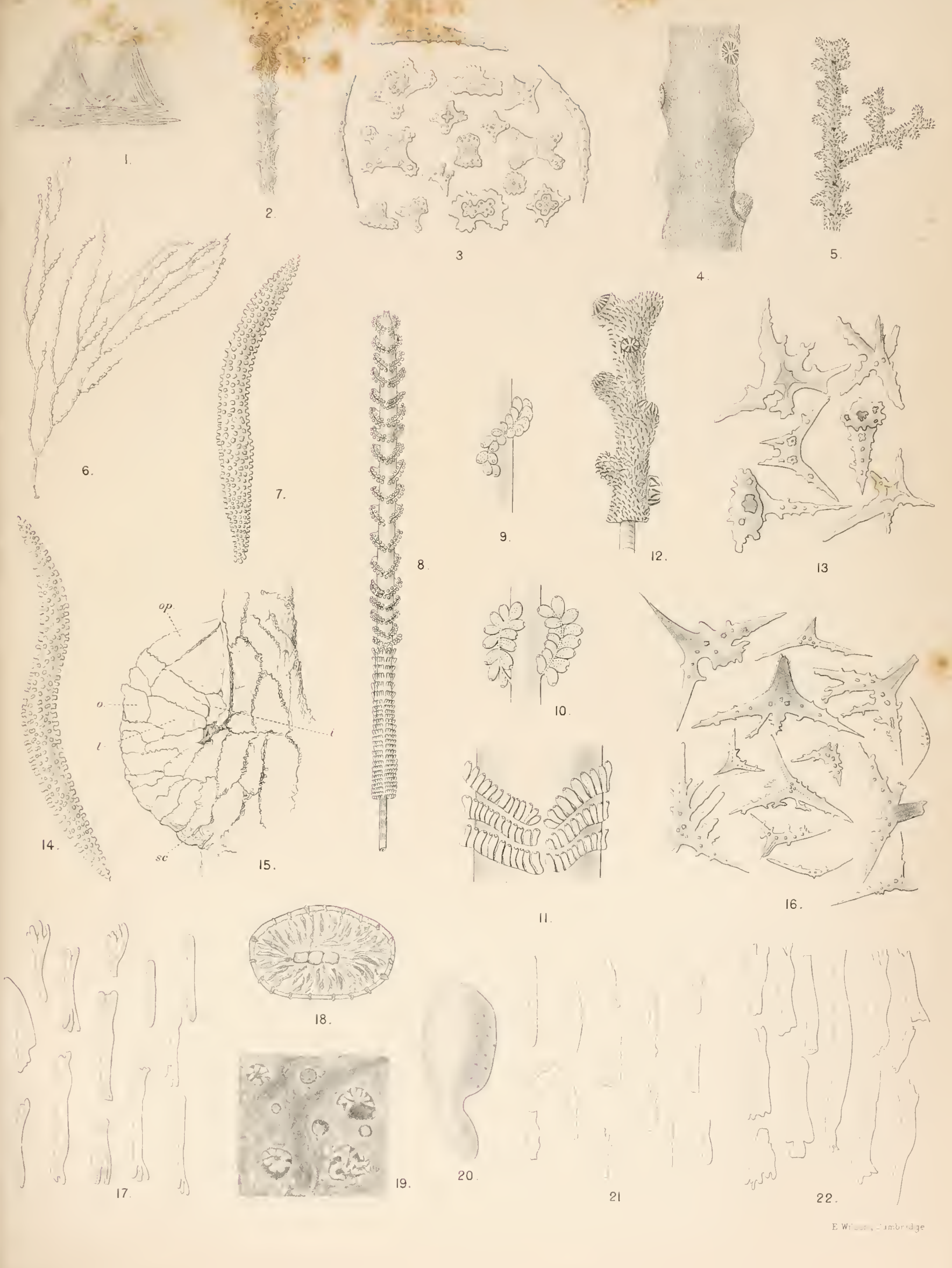
Cavernularia obesa, VALENCIENNES.
**Stylobelemnoides herdmani*, n. gen. et sp.
**Fusticularia herdmani*, n. gen. et sp., SIMPSON.

* There are thus forty-two new species described in this report.

† RIDLEY has changed this title to *Gorgonia australiensis*, 'Journ. Linn. Soc., Zool.,' xxi. (1888), p. 238.
‡ Non *Virgularia tuberculata*, MARSHALL, 1883 (= *Virgularia cladiscus*, JUNGERSEN, 1904).

EXPLANATION OF PLATE.

Fig. 1. *Chironephthya indica*, n. sp.; two groups of anthocodial "point" spicules.
,, 2. *Muricella rubra*, n. sp.; showing texture of the surface. × 2.
,, 3. *Bebryce indica*, n. sp.; spicules.
,, 4. *Suberogorgia rubra*, n. sp.; showing texture and verrucæ. × 10.
,, 5. *Acamptogorgia rubra*, n. sp.; showing branching and the alternate verrucæ. × 2.
,, 6. *Caligorgia versluysi*, n. sp.
,, 7. *Muricella rubra*, n. sp.; spicule.
,, 8. *Virgularia calycina*, n. sp.; the entire specimen.
,, 9, 10, 11. *Virgularia calycina*, n. sp.; pinnules at various levels.
,, 12. *Acamptogorgia gracilis*, n. sp.; showing spinose texture of the cœnenchyma, and the eight triangles of anthocodial spicules. × 10.
,, 13. ,, ,, types of spicules.
,, 14. *Chironephthya indica*, n. sp.; a large curved spindle with tubercles.
,, 15. *Caligorgia versluyi*, n. sp. Drawn by Dr. Versluys. *op.*, operculum; *o.*, abaxial row; *l.*, outer lateral row; *i.*, inner lateral row; *sc.*, basal scale of abaxial row, or belonging to general cœnenchyma.
,, 16. *Acamptogorgia rubra*, n sp.; types of spicules.
,, 17. *Fusticularia herdmani*; spicules of the body parenchyma.
,, 18. ,, transverse section of the stock, showing three central canals.
,, 19. ,, portion of the surface enlarged, showing different stages of retraction of autozooids.
,, 20. ,, entire colony. Natural size.
,, 21. ,, spicules of the cortical layer.
,, 22. ,, spicules of the trunk.



E. Wilson, Cambridge

REPORT

ON THE

SOLITARY CORALS

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

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FELLOW AND TUTOR OF NEW COLLEGE, OXFORD.

[WITH FOUR PLATES AND FIVE FIGURES IN THE TEXT.]

THE following paper contains an account of a small but remarkably interesting collection of Solitary Corals from Ceylon, which Professor HERDMAN has kindly entrusted to me for identification and description. The collection includes five species of Turbinolidæ, of which two are apparently new to science, three species of Flabellidæ, six species of Fungiidæ and seven species of Eupsammiidæ. There are, in addition, some specimens of *Cyathohelia*, sp. *incert.*, and other colonial corals, but as it is my intention to confine myself to a description of the solitary corals and to species closely related to them, these compound forms will not be included in the present memoir.

As every student of corals knows, the classification and identification of the Turbinolidæ and Eupsammiidæ is attended with no inconsiderable difficulties. The greater number of the genera and species described by MILNE-EDWARDS and HAIME (**35** and **36**) were fossil and the type specimens have been inaccessible to me. The researches of the last forty years have added a considerable number of recent, as well as fossil species, some of which are undoubtedly identical with forms described by older authors; others are undoubtedly new, but many must be regarded as doubtful, for there is ample evidence that varieties have frequently been classed as species, and the identity of recently discovered living genera and species with previously described

fossil species has in several cases been overlooked. Hence one cannot deal with any collection of Turbinolidæ and Eupsammiidæ, however small, without entering upon a criticism of these families, and, unfortunately, my claims to undertake such a criticism are limited. A short study of the literature of the subject is sufficient to convince one that no sufficient degree of exactitude can be attained without a study of the original specimens on which the genera and species were founded. But these are largely contained in foreign museums, which I have been unable to visit, or were included in private collections which have been dispersed and are no longer traceable. The British Museum is rich in the possession of the "Challenger" collections and in duplicates of species collected by POURTALÈS, but it is singularly poor in Eupsammiidæ, and a careful search among the named specimens of this family failed to bring to light anything that was of assistance in disentangling the difficulties attendant on its classification. I have, therefore, had to rely chiefly on published descriptions and illustrations, and these are, in many cases, too vague and inaccurate to be of material assistance.

I wished, when I undertook this piece of work at Professor HERDMAN'S request, to make a thorough examination of the anatomy of the soft parts as well as of the coralla of the specimens he entrusted to me, but this I found was impossible, as several of the more important species were represented only by a single specimen and it was necessary to dissolve away the soft parts in order to identify the coralla. I have, however, made a tolerably thorough investigation of the anatomy of three forms, *Heterocyathus æquicostatus*, *Heteropsammia michelinii*, and *Dendrophyllia gracilis*. As a matter of convenience this paper will be divided into two sections, the first dealing with the systematic description of the coralla contained in Professor HERDMAN'S collection, the second with the details of the anatomy of the three above-mentioned species.

PART I.—SYSTEMATIC.

FAMILY: TURBINOLIDÆ (*pars.*), M. EDWARDS AND HAIME.*

M. EDWARDS and HAIME divided the Turbinolidæ into the two sub-families Caryophyllinæ, with one or more crowns of pali, and Turbinolinæ, without pali. The Caryophyllinæ were further subdivided into Caryophylliaceæ, with a single circle of pali, and Trochocyathaceæ, with more than one circle of pali. The Turbinolinæ were subdivided into the Turbinoliaceæ, destitute of epitheca, and Flabellaceæ, in which "the wall is completely covered by a pellicular epitheca." MARTIN DUNCAN, in his revision of the families and genera of the Madreporaria (**13**), abolished the sub-families

* 'Ann. des Sci. Nat.,' 3e sér., t. ix., 1848, and 'Hist. Nat. des Corall.,' t. ii., p. 7, 1857; P. M. DUNCAN, "Revision of the Madreporaria," 'Journ. Linn. Soc.,' vol. xviii., "Zoology," 1885.

of M. EDWARDS and HAIME depending on the presence or absence of pali, and created in their stead three sub-families Turbinolidæ simplices, Turbinolidæ gemmantes and Turbinolidæ reptantes. The first of these includes nearly the whole of the Caryophyllinæ and Turbinolinæ of M. EDWARDS and HAIME and is divided into seven alliances, viz., Smilotrochoida, Flabelloida, Placotrochoida, Turbinoloida, Trochocyathoida, Discocyathoida and Haplophylloida. Want of space and want of material forbid my entering upon a criticism of DUNCAN'S classification, and I must content myself with remarking that it has been of no great assistance to systematists, and that the older classification of M. EDWARDS and HAIME has been generally preferred to it by recent writers. Both classifications agree in placing the genus *Flabellum* and its allies as a subordinate group of the Turbinolidæ, and the most recent writer on the genus *Flabellum*, Mr. J. STANLEY GARDINER (22), adopts the classification of DUNCAN, giving, however, a definition of the "Flabelloida," which I cannot find anywhere in DUNCAN'S paper. As I shall have to enter more fully into the structure and classification of *Flabellum* and its allies in a subsequent part of this paper, I need only say here that I am of the opinion that they differ from all other Turbinolidæ in several important characters, but chiefly in the fact that their wall is a persistent prototheca (BERNARD, 4), which is not thickened externally by a secondary deposit of calcareous substance laid down by an "edge zone" or "perisarc," this latter structure being, indeed, absent. They must, therefore, be classified apart in a family Flabellidæ, and the Turbinolidæ, after the removal of the Flabellidæ, may be defined as follows:—

Corallum simple, or forming colonies by gemmation from the wall or from stoloniform basal outgrowths. The wall is thickened externally by the secondary deposit of calcareous tissue formed by the edge-zone, and is solid, variously ornamented with costæ, granules and spines, the spaces between the costæ sometimes filled up by the deposit. The upper part of the wall commonly formed by the union of the enlarged outer ends of the septa. Epitheca, when present, pellicular or lamellar, closely adherent. The septa commonly exsert and solid. Septal loculi open to the base. Pali may or may not be present. Columella present or absent; when present it may be essential or parietal and of very various shape and composition.

Paracyathus, M. EDWARDS and HAIME.*

This genus is easily recognised by its numerous lobate pali, scarcely distinguishable from the prominences of the columella. The pali, however, should more correctly be described as paliform lobes, as they are clearly thickenings of the inner ends of the septa, and the outermost of the several crowns, at any rate, do not extend to the base. The original definition of the genus given by M. EDWARDS and HAIME, in

* 'Ann. des Sci. Nat. Zool.,' 3e sér., t. ix., p. 318, 1848; 'Hist. Nat. des Cor.,' t. ii., p. 52, 1857; P. M. DUNCAN, "Rev. Madrep.," 'Journ. Linn. Soc.,' vol. xviii., "Zool.," p. 24, 1885.

1848, was amended in the 'Hist. Nat. des Coralliaires'; in the former the columella was described as "très developpée," the pali as "très élevés," but both these characters are exceedingly variable, and in the 'Hist. Nat. des Coralliaires' the definition of the structures in question runs thus: "La columelle est formée des tigelles qui paraissent naître du bord interne et inférieur des cloisons, et qui sont d'autant plus élevées qu'elles sont plus éxtérieures; sa surface est papilleuse et concave. Les palis paraissent se detacher également de la partie inférieure des cloisons, et se distinguent à peine des tigelles columellaires." The species of the genus are not easy to determine with certainty. LACAZE DUTHIERS (**33**) gives excellent photographs of *P. striatus*, and DUNCAN (**11**) gives several species from different parts of the world, but all these are obviously different from the specimens in Professor HERDMAN'S collection. It should be observed that the initial and therefore solitary corallites of the arborescent *Cyathohelia* closely resemble *Paracyathus*, the septal pali and columella being almost identical, and I am inclined to think that several of the described species of *Paracyathus* are nothing more than young Cyathoheliæ.

Paracyathus stokesi, M. EDW. and H.

There are three specimens of *Paracyathus* in Professor HERDMAN'S collection; they were taken at different times from different localities and differ from one another in details, but their resemblance is sufficiently close to lead me to refer them all to *P. stokesi*, M. EDW. and H. (**35**, plate x., figs. 7 and 7A).

Specimen *a* is from Trincomalee. The corallum is 17 millims. in height; the calice elliptical, its longer axis measuring 13 millims., its shorter axis 8 millims. The calice is depressed at either end of the long axis. The septa correspond very closely with M. EDWARDS and HAIME'S description of *P. stokesi*, but the fifth cycle is incomplete, and the outer ends of the primary and secondary septa are scarcely, if at all, thickened. The costæ differ from those of *P. stokesi*, in being so slightly developed that they are scarcely distinguishable at a short distance below the level of the calice.

Specimen *b* is from Galle. Height of corallum 14 millims.; longer axis of the calice 12 millims.; shorter axis 9 millims. Septal arrangement as in specimen *a*, but the septa are rather thicker externally. The calicular fossa is deeper, the columella less developed, and the septal pali stouter and more prominent than in *a*. The costæ agree exactly with M. EDWARDS and HAIME'S description of *P. stokesi;* they are rather broad, distinct to the base, and thickly covered with granules.

Specimen *c* is from deep water near Galle. Height of corallum 14 millims.; longer axis of calice 7 millims.; shorter axis 6 millims. This specimen resembles *P. procumbens*, M. EDW. and H., from the Eocene of Hauteville, in the following characters. The corallum is curved and the calice inclined to one side; the calice is subcircular and rather deep; the septa are somewhat exsert and their external ends project

beyond the lip of the calice; the costæ are somewhat slender and form sharp ridges projecting unequally at different levels, but never prominently. On the other hand, it resembles *P. caryophyllus*, from the Eocene of Sheppey, in having only four cycles of septa. (It seems very probable that these two Eocene species are identical, the presence or absence of a fifth cycle of septa not being sufficient to distinguish them.)

I have no hesitation in referring *a* and *b* to *P. stokesi*, but I am more uncertain about *c*. If it cannot be referred to this species, it cannot be anything else than *P. procumbens;* but a comparison of M. Edwards and Haime's figures (**35**, plate x., figs. 6 and 7) lead me to believe that the latter species is only a variety of *P. stokesi*, and that the three Ceylonese specimens are local varieties of that species.

Paracyathus striatus, Philippi.

Cyathina striata, Philippi, 'Arch. für Natur.,' 1842, vol. 1, p. 48.
Paracyathus striatus, M. Edwards and Haime, 'Pol. foss. des terr. palæoz.,' 1851, p. 25.

A single specimen, from deep water off Galle, which only came into my hands after this paper was written, must clearly be referred to this species.

Rhodocyathus, n. gen.

Corallum simple, free, saucer-shaped, with signs of former adherence. Calice subcircular, wide, shallow. Columella essential, well developed, composed of numerous oblique thin overlapping lamellæ whose upper edges are produced into numerous flattened spines. Septa in six systems and five cycles, the last cycle incomplete. The primary and secondary septa subequal, very exsert, arched at their outer ends and sloping inwards to join the columella; their upper margins furnished with blunt spines; their outer margins produced into sharp and prominent spines where they pass into the costæ; the surfaces of the septa marked with broad radiating ridges corresponding to the marginal spines, the whole surface finely granular. Tertiary septa similar to the primaries and secondaries, but smaller and less exsert. The quaternary much smaller than the tertiary septa, and bending inwards to join the latter near the columella. The quinary septa mostly very small and free at their inner ends; where they are longer they generally become attached to an adjacent septum, usually to a quaternary, but in some cases to a primary, secondary, or tertiary; the inner ends of the quinary and quaternary septa are very thin and cribriform. The costæ corresponding to the first four cycles of septa form distinct fairly prominent ridges covered with fine granulations; those corresponding to the fifth cycle very small; the costæ of opposite ends meet below and cover in the basal scar of attachment.

Rhodocyathus ceylonensis, n. sp.—Plate I., figs. 1 and 1a.

The characters are those of the genus. A single specimen from Trincomalee.

The dry corallum is of a yellowish colour, and measures about 18 millims. in height

from the rounded base to the top of a primary septum. The calice is subcircular, measuring 35 millims. in its longer and 33 millims. in its shorter diameter. The columella is oval, measuring 10 millims. × 6 millims., and has a horizontal surface. The specimen was evidently fixed in early life and has become detached, the scar of detachment being healed over in a peculiar manner by the continuation of sixteen costæ round the bottom of the corallum, to meet and fuse with their fellows of the opposite side. These costæ belong to the septal systems at either end of the longer axis of the calice; the costæ of the lateral systems converge below and unite to form two somewhat irregular and not very conspicuous lateral basal prominences. The specimen was completely covered by soft tissues, but these had to be removed to facilitate the study of the corallum.

I have been unable to refer this specimen to any known genus, and have therefore made the new genus *Rhodocyathus* to contain it. The name is descriptive of the shape of the calice, which bears a resemblance to a conventional rose. It differs from all the members of DUNCAN's Turbinoloida in the characters of the columella. It is distinguished from the majority of the Trochocyathoid alliance by the absence of pali, and its shape and the character of its septa and costæ mark it off from the somewhat vague and all-embracing genus *Ceratotrochus*, as defined by DUNCAN. It cannot be placed in any genus of the Discocyathoid alliance, nor yet among the Haplophylloida. The presence of a columella separates it from all the Smilotrochoida; the character of the columella prevents its being placed among the Placotrochoida; and it certainly is not a Flabelloid. The genus shows most affinity to *Ceratotrochus* and *Deltocyathus*, and may be described as a Trochocyathoid without pali.

Cyathotrochus, n. gen.

Corallum simple, free, without a trace of adherence, forming a short, laterally compressed cone. Costæ moderately prominent near the lip of the calice, but scarcely distinguishable below and indistinguishable near the bluntly pointed base; the primary and secondary costæ somewhat more prominent than the tertiaries, which in turn are rather more prominent than the quaternaries; the costæ corresponding to the primary septum at each end of the longer axis of the calice much more prominent than the rest and continued as sharp ridges about half-way down the corallum, but not forming aliform expansions. Calice elliptical, subplane. Columella essential, with a papillary upper surface, projecting slightly in the calice. Septa in six systems and four regular cycles; the primary and secondary septa subequal, moderately exsert, arched above, with nearly vertical inner margins, their surfaces ornamented with rows of relatively large granules, arranged nearly parallel to the inner margins. Paliform lobes, separated from the septa by a deep but narrow notch, stand in front of the first three cycles of septa and connect them with the columella; those in front of the tertiaries are the largest, but they do not form chevrons or deltas.

Cyathotrochus herdmani, n. sp.—Plate I., figs. 2 and 2A.

Height of corallum, 7 millims.; longer axis of calice, 10 millims.; shorter axis, 7·5 millims. The characters are those of the genus. The septa and the bluntly pointed basal part of the corallum are white, the rest of the wall of a dull Indian-red colour. The wall and costæ are covered with close-set but very fine granules, which can only be distinguished by the aid of a strong lens. A single specimen from the west of Periya Paar.

After some hesitation I have founded a new genus to receive this species, which does not correspond exactly with any described genus of the Turbinolidæ. It is undoubtedly closely allied to *Trochocyathus*, from which it differs only in the form of the pali, which should perhaps be described as paliform lobes rather than true pali, as they are evidently the thickened inner continuations of the septa, separated from the latter by a notch which, although fairly deep, does not extend to the bottom of the septum. These pali, or paliform lobes, form a single crown, not two crowns as in *Trochocyathus*, and they do not form chevrons as in *Tropidocyathus*. The characteristic feature of the species is the keel-like projection of the costæ at each end of the long axis of the corallum, suggesting an affinity to *Tropidocyathus* (*Trochocyathus*) *lessoni*. But in this latter species, as MICHELINS' (**34**) and ALCOCK'S (**3**) figures show very clearly, the corresponding costæ are very much enlarged and form aliform expansions extending round the base of the corallum, whereas in *Cyathotrochus* they are but slightly enlarged to form ridges extending scarcely half way to the base.

Heterocyathus, M. EDWARDS and HAIME (**35**).

Stephanoseris, M. EDWARDS and HAIME (**38**).

Heterocyathus æquicostatus, M. EDW. and H.

Stephanoseris rousseaui, M. EDW. and H., 'Hist. Nat. des Cor.,' t. iii., p. 56, 1860.
H. philippinensis, SEMPER, 'Zeit. Wiss. Zool.,' xxii., p. 254, 1872.
H. parasiticus, SEMPER, *loc. cit.*
H. pulchellus, REHBERG, 'Abh. Ver. Hamb.,' xii., p. 8, 1892.
H. oblongatus, REHBERG, *loc. cit.*
H. æquicostatus, J. C. GARDINER, 'Mar. Invest. in South Africa,' "Turbinolid Corals," 1904.

Professor HERDMAN'S collection contains numerous specimens of this interesting species, of all sizes, and apparently collected from all the localities in which he dredged.

Mr. STANLEY GARDINER has recently shown how very variable this species is, and has absorbed the various species of SEMPER and REHBERG. The Ceylonese specimens also show great variety, and, though I have not as large a collection for comparison as Mr. GARDINER, I have no doubt of the identity of these specimens with *H. æquicostatus*, and further, I have no doubt that the forms first described by

M. Edwards and Haime as *H. rousseaui* and afterwards as *Stephanoseris rousseaui* are identical with *H. æquicostatus*.

The genus *Stephanoseris* was created, M. Edwards and Haime tell us, to contain the species first described by them as *H. rousseaui*, but subsequently found to possess synapticula, the presence of which involved its removal to the Fungiidæ. Subsequent authors, including Duncan, have accepted the genus *Stephanoseris*, the last-named remarking that he places it with much doubt among the Fungiidæ, for he could not find synapticula in any of his specimens. Omitting for the moment any reference to synapticula, we find that *S. rousseaui* differs from *H. æquicostatus* (1) in having costæ of unequal size, the tertiaries being particularly large; (2) in having four instead of five cycles of septa; (3) in the fact that the septa do not project externally.

Among the specimens in Professor Herdman's collection there are individuals with all the characters of *H. æquicostatus*, and every intermediate grade between these and individuals identical with *S. rousseaui*. Further, I have found well-marked synapticular structures in every individual that I have examined, so there can be no doubt that the forms described as *Stephanoseris rousseaui* are only varieties of the forms described as *Heterocyathus æquicostatus*, and for reasons that I will explain in the latter half of this paper I prefer to retain the latter name and to place the genus among the Turbinolidæ. Synapticula have been found to be common to so many different kinds of corals that their presence is no longer a reason for including any given form among the Fungiidæ. It should be mentioned that the synapticula of *Heterocyathus* cannot be seen on mere inspection of the corallum, as they are hidden by the swollen upper ends of the septa. In order to see them it is necessary to make sections or to grind down the corallum below the level of the exsert septa, when they are at once apparent, as is seen in fig. II. Thus one can easily understand how both M. Edwards and Haime and Duncan, as well as other authors, have failed to recognise their presence. The genus *Psammoseris* is described by M. Edwards and Haime as resembling *Stephanoseris* (*Heterocyathus*) in almost every respect, except that it has no pali. Not having access to the type specimens of *Psammoseris*, I cannot speak with certainty on this subject, but I am inclined to think that the genus was founded upon a variety of *Heterocyathus*, in which the pali are so slightly developed as to be indistinguishable from the papilliform columella. An inspection of Gardiner's excellent photographs of *Heterocyathus* (**23**, plate iii., figs. 13 to 19) shows that such a reduction of the pali is not uncommon. *Psammoseris*, like *Heterocyathus* and *Heteropsammia*, fixes itself in the young state on a gastropod shell, which it subsequently envelops, and in the adult the shell, and the spiral basal cavity continuous with it, is tenanted by a Sipunculid of the genus *Aspidosiphon*. I shall refer to this interesting association in a subsequent part of this paper, and I give in the second part a detailed account of the anatomy and minute structure of the corallum of *Heterocyathus*.

FAMILY: FLABELLIDÆ.

Simple corals, multiplying asexually by transverse fission from a fixed nurse-stock. Corallum more or less compressed and flabelliform or cuneiform. Calice elongated; elliptical or angular at the extremities of the long axis. Septa numerous, increasing in number during the growth of the corallum, chiefly by the addition of new septa in the systems contiguous to the directive septa, in such a manner as to appear to be arranged in a variable number of ternary systems. The columella may be essential and lamellar, or parietal and formed by the union of spines or trabeculæ projecting from the lower ends of the principal septa. The wall is protothecal, and increases in thickness only by addition to the inside surface. There is no edge-zone. Costæ rudimentary or absent. Protothecal spines commonly present. Genera :—*Flabellum*, LESSON, and *Placotrochus*, M. EDWARDS and HAIME.

The Flabellidæ, as characterised above, differ from all the other Turbinolidæ, among which they have hitherto been placed, in the absence of an edge-zone, that is, of soft tissues external to the wall. The wall, as VON KOCH pointed out (**30**), is an "epitheca," or, if we adopt the more exact nomenclature of BERNARD, a "prototheca," that is to say, it is a direct upward continuation of the primitive basal cup common to all Madreporarian corals, of which the development has been carefully described by VON KOCH (**28**), DE LACAZE DUTHIERS (**33**), and DUERDEN (**10**). As there are no soft tissues external to the prototheca, it can only increase in thickness by addition from within, and a section of the wall of *Flabellum* shows that the "dark line of growth," which lies in or near the middle of the theca of other corals, is here on the outside. As the wall does not increase in thickness externally, the costæ are very feebly developed, and there is an absence of the ridges, spines, and other external ornamentations formed by the deposit of additional calcareous matter on the outside of the wall by the activity of the calicoblasts of the edge-zone. The spinous processes and rootlets found in most members of the Flabellidæ are hollow, and only become solid by the secondary deposit of calcareous matter within. Thus they differ from ordinary costal spines, and their mode of formation, by local extensions of the lip of the calice, has been indicated by DE LACAZE DUTHIERS (**33**). In all the Turbinolidæ, as here limited, there is a distinct and usually well-developed edge-zone. Hence the wall increases in thickness, both externally and internally, and there are well-developed costal ridges, variously ornamented with granules, tubercles, or spines, or sometimes the furrows between the costal ridges may be filled up by a secondary deposit of an "epithecal" character, formed by the calicoblastic layer of the edge-zone. Moreover, in the typical Turbinolidæ, the septa grow in height well beyond the limits of the protothecal cup, and are either prominently exsert or their peripheral margins are thickened and become attached to one another, forming the so-called pseudotheca of ORTMANN. The marked difference in the structure and growth of the wall seems a sufficient reason for separating *Flabellum* and its allies

from the rest of the Turbinolidæ, and placing them in a separate family, Flabellidæ, and the septal arrangements and the peculiar mode of multiplication by transverse fission, characteristic of the family, are additional reasons for keeping it apart. GARDINER (**23**) has shown that the genera *Blastotrochus*, M. EDW. and H., and *Rhizotrochus*, M. EDW. and H., must be absorbed. I have not been able to examine DUNCAN'S fossil genus *Thysanus*, and I do not include it in the family Flabellidæ, as here defined, because it has well developed granular and minutely spined costæ, which seem to indicate an external thickening of the wall.

The genus *Placotrochus* was not included by DUNCAN (**13**) in his alliance Flabelloida, but was placed, along with *Sphenotrochus*, *Nototrochus*, *Placocyathus*, and *Platytrochus* in an alliance Placotrochoida, characterised by the presence of an essential lamellar columella. For this I can find no justification whatever. *Placotrochus* has no edge-zone ; its wall is protothecal and devoid of costæ ; it has the compressed flabelliform or cuneiform shape characteristic of *Flabellum ;* it reproduces itself asexually by transverse fission from a nurse-stock, and the truncated free forms have a basal scar exactly like that of *Flabellum ;* it has protothecal spines ; its septal arrangements are those of *Flabellum*. The only point of difference is the essential lamellar columella, but this cannot outweigh the other characters, and the well-preserved specimens of this genus in Professor HERDMAN'S collection show that the general anatomy of the polyp is the same as that of *Flabellum*, though I have not yet completed my study of its microscopic structure. I have no hesitation in placing it in the family Flabellidæ.

Flabellum, LESSON (1831).

A detailed criticism of this genus has recently been given by GARDINER (**22**), to which the reader is referred. The subdivisions *Subpedicellata truncata* and *fixa*, of M. EDWARDS and HAIME, were shown by SEMPER (**49**) to be purely artificial, and DUNCAN'S subdivisions of the genus (**13**, p. 13) are still more arbitrary and unnatural. SEMPER, and more particularly GARDINER, have shown that most of the living species enumerated in the 'Hist. Nat. des Coralliaires,' must be regarded as varieties of a few distinct species, and the latter author has reduced most of M. EDW. and HAIME'S, as well as SEMPER'S species to varieties of either *F. pavoninum*, LESSON, or *F. rubrum*, QUOY and GAIMARD, the latter species being apparently protean in its characters. I speak with all diffidence, for I have not had the opportunity of comparing a large number of specimens, but I am inclined to think that GARDINER has gone too far.

Flabellum crassum, M. EDW. and H.—Plate I., figs. 3 and 3A.

There are in Professor HERDMAN'S collection two specimens of *Flabellum*, from the pearl banks in the Gulf of Manaar, which agree in almost every respect with SEMPER'S description and figures of *F. irregulare*. Both specimens were preserved in spirit ; one I have decalcified, the corallum of the other when cleaned and dried measures

30 millims. in height. The longer axis of the calice measures 16 millims., the shorter axis 8 millims.; the small scar at the base 4 millims. × 2 millims.; thus the ratio of the axes is 2 : 1, agreeing with SEMPER'S description. The corallum is compressed, with rounded directive edges, whose sides form an angle of 23° in the dry specimen, but a considerably wider angle in the decalcified specimen. The wall is constricted at tolerably regular intervals and there are three short and stout spines at varying heights on the directive faces, and two short and corroded spines near the basal scar. The costæ, especially those corresponding to the principal septa, are distinct and are recognisable nearly down to the basal scar. The corallum is tall, and the directive margins of the calice are nearly level with the lateral margins. The fossa is very deep (6 millims.), narrow and slit-like. The parietal columella is formed by the union of trabeculæ given off from the lower ends of the principal septa. There are in all sixty-six septa; the primaries and the secondaries are of equal size and unite in the columella. The twelve tertiaries are nearly equal in size to the primaries and secondaries and also join the columella. The fourth cycle septa are short, excepting those nearest the two directive septa at opposite ends of the long axis of the calice; these are nearly as large as the tertiaries and join the columella. Fifth cycle septa are developed in the chambers between the primary and secondary septa on both sides of the two directive septa, and are equal in size to the lateral tertiary septa. In one chamber nearest to a directive, two sixth-cycle septa are developed, one on either side of a quinary septum (see fig. 3A). (This interpretation of the septal succession differs from SEMPER'S, who explained an exactly similar arrangement by supposing that additional second-cycle septa were developed in each of the terminal systems, but it is clear that what he describes as additional secondary septa are nothing more than third-cycle septa, which have grown to the same size as the primaries and secondaries.) The result of this arrangement is that there appear to be sixteen ternary systems, and, in addition, two small septa in one of the systems. The principal septa have very slightly arched, or nearly horizontal, upper edges; their inner edges descend vertically to the columella, and they are distinctly, though slightly, notched near their insertions on the wall. The surfaces of the septa are thickly covered with fine spinose granules, which have an obscurely radial arrangement. The dry corallum is brilliantly white in colour, and the lower five-sixths of the wall is encrusted by a secondary calcareous deposit, which, on decalcification, proves to be formed by interlacing algal filaments, as described by FOWLER for *F. patagonichum* (14). It is noteworthy that the costæ are more conspicuous in the region of this secondary deposit than they are at the upper end of the corallum.

These Ceylonese specimens are so similar in all respects to the figures and description of SEMPER'S *F. irregulare* that there can be no doubt of their identity. According to GARDINER (22), *F. irregulare*, SEMPER = *F. rubrum*, QUOY and GAIMARD, and there is certainly some resemblance between his (not wholly satis-

factory) figs. 26, 30, 31 and the Ceylonese specimens, while the latter can certainly be included in the amended definition of *F. rubrum* given by GARDINER on p. 28. It is further stated that *F. variabile*, SEMPER, is connected with *F. rubrum* by individuals, SEMPER'S species being identified by MOSELEY with *F. stokesi*, M. EDWARDS and H., which in turn is identical with *F. oweni*, *aculeatum*, *spinosum*, *debile*, *sumatrense* and *candeanum*. I must take leave to doubt whether these identifications are correct. That *F. variabile*, SEMPER, is identical with *Flabellum* (*Turbinolia*) *rubrum*, QUOY and GAIMARD, I have no doubt. The characters of the corallum are similar and a comparison of SEMPER'S figure of the expanded polyps (**49**, plate xviii., fig. 1) of *F. variabile* with QUOY and GAIMARD'S figure of *F. rubrum* (**46**, plate xiv., figs. 5 to 9) show a very close correspondence in the coloration of the living animal; in both there are the same six alternating radial bands of deeper red and lighter red or yellow. On the other hand, *F. irregulare*, as described by SEMPER, is red with as many radial white lines as there are principal septa. The colour, no doubt, is variable to some degree, but it must be taken into account, and what I wish to point out here is, that SEMPER is the only author who has paid special attention to the colour of the living polyp; that he had at least as many specimens for comparison as GARDINER; that he found a constant colour-difference between his *F. variabile* and *F. irregulare*, and that the colour of the former, and not that of the latter, corresponds to QUOY and GAIMARD'S figure of *F. rubrum*. It follows, therefore, that *F. variabile* = *F. rubrum*, and, as SEMPER showed beyond all cavil, *F. stokesi*, *oweni*, *aculeatum*, *spinosum*, *debile* and *sumatrense*, all M. EDW. and H., are synonyms of *F. variabile*.

The Ceylonese specimen, which I identify with *F. irregulare*, SEMPER, agrees very closely with *F. crassum*, M. EDW. and H., especially in the characters of the septa, which are notched near their insertion on the wall (**38**, plate viii., fig. 8A), and have thickened and rugose internal borders. SEMPER observes that the two species are very closely allied, differing chiefly in the height of the corallum. There can be no doubt that they are identical; the specific name *crassum* has the priority, and I therefore identify the Ceylonese specimen above described as *F. crassum*, M. EDW. and H.

Flabellum rubrum, Q. and G.—Plate I., fig. 4.

There are three other specimens of *Flabellum* in Professor HERDMAN'S collection: *a* and *b* (locality not recorded), and *c* from deep water near Galle. These are all truncate forms with a fairly large basal scar; their measurements correspond closely, their calices are elliptical, their calicular fossæ wider, and the septa are thinner, and their inner margins less vertical than those of *F. crassum*, and the spines on the surfaces of the septa are longer, further apart, and definitely arranged along radial thickenings of the septa. Their walls are thinner than in *F. crassum*, the costæ are of equal size and very slightly developed, and the corallum is not constricted at

intervals as in that species, but only exhibits a succession of somewhat sinuous lines of growth parallel to the curved margin of the calice. The three specimens differ from one another in colour, in the characters of the lower edges of the septa, and of the trabeculæ forming the parietal columella, but their resemblances are so great that I must refer them to one species, viz., *F. rubrum*, Quoy and Gaimard.

Specimen *a*.—Height, 12 millims.; calice, 15 millims. × 8·5 millims.; scar, 6 millims. × 3·5 millims.; depth of calice, 5 millims. Angle formed by the directive faces of the wall, 37°. The dry corallum is white and has a small directive spine at each end of the scar. The margin of the calice is entire, the directive ends of the calice 2 millims. lower than the sides. There are eighty-two septa, whose character and arrangement are shown in fig. 4. The lower margins of the septa are furnished with sharp spines, but are not sinuous; the septal trabeculæ uniting to form the columella are large and spiniform. The character of the trabecular columella approximates this specimen to *F. profundum*, M. Edw. and H., which is a variety of *F. rubrum*.

Specimen *b*.—Height, 13 millims.; calice, 17 millims. × 8·5 millims.; scar, 7 millims. × 3·5 millims.; depth of calice, 4·5 millims. Angle formed by directive faces of wall, 45°. The dry corallum is of a brownish-grey colour and bears short protothecal spines at either end of the scar. The calicular margin is crenulate, the directive ends of the calice about 2 millims. lower than the sides. There are eighty septa arranged in twenty apparent ternary systems. Eight of the tertiary septa are equal in size to the primaries and secondaries and unite with them in the columella, but four of the laterally placed tertiaries are of smaller size, and either barely reach, or do not reach, the columella. The principal septa are thin, their inner margins slope obliquely into the fossa, their lower edges are expanded and slightly sinuous and terminate in nodular trabeculæ, which unite to form the columella. The septal surfaces bear distinct radial ridges ornamented with spiniform granules. This specimen is clearly identical with *F. crenulatum*, M. Edw. and H., which is a variety of *F. rubrum*.

Specimen *c*.—Height, 13 millims.; calice, 15 millims. × 9 millims.; scar, 8·5 millims. × 4 millims.; depth of calice, 5 millims. Angle formed by the directive faces of the wall, 35°. The wall in the dry corallum is of a deep reddish-brown colour, and the same colour extends half way across the septa, a peculiarity which Semper (**49**, p. 250, footnote) says is confined to *F. pavoninum* and *F. distinctum*. The concentric lines of growth on the wall are distinct, the costæ are scarcely recognisable, and there are no protothecal spines. The calicular margin is entire, the directive ends of the calice are about 1½ millims. below the lateral margins. There are seventy-two septa, the tertiaries equal in size to the primaries and secondaries and meeting them in the columella. The fifth cycle is complete in the terminal systems, but incomplete in the lateral systems. The septa resemble those of specimen *b*, but their inner edges are more vertical and their lower ends more decidedly sinuous.

The calicular fossa is rather narrow, and the septal trabeculæ forming the columella short and bluntly spiniform. This specimen might be referred either to *F. rubrum* or *F. stokesi*, M. Edw. and H.; but it cannot be either *F. pavoninum* or *distinctum*, the colour of the septa notwithstanding. These three specimens, therefore, are varieties of *F. rubrum*, Quoy and Gaimard, which is synonymous with *F. variabile*, Semper, but is, in my opinion, distinct from *F. crassum*, M. Edw. and H. (= *F. irregulare*, Semper).

I differ, with some hesitation, from Mr. Gardiner, but I feel bound to point out that his reasons for uniting nearly all the described species of *Flabellum* under *F. rubrum* are not satisfactory. He relies very much on certain numbers and measurements, and he appears to think that if one form is connected with another by some individuals, the two must be reckoned as constituting one species. Now, in the first place, much depends on the numbers or measurements that are chosen for comparison. Two of his characters, viz., the number of septa fusing by trabeculæ and the total number of septa, are characters depending on the age of the coral, and are therefore of little value. His third character, the relation of the length to the breadth of the calicle, is tolerably constant at all ages after maturity, and is therefore better. But whatever characters are chosen, it is not sufficient to set out the results of the measurements in a simple table and to say that, since the average measurements of a number of unequal groups of individuals can be arranged in a continuous series, all the specimens measured must belong to one species. To deal with the statistics of a number of individual forms, proper statistical methods must be employed, or systematic zoology will be thrown into confusion. The extreme measurements—the characters that vary most widely from the mean—of two closely allied species may be expected to overlap, but the fact of their overlapping does not break down the distinction between two species whose mean is different. We have at present no data for determining the range of variation in the species of *Flabellum* by statistical methods, and until such data are available I prefer to place reliance as much upon such characters as the shape of the columellar trabeculæ, the shape and thickness of the septa and the kind and arrangement of the granules on their surfaces, the visibility or otherwise of the costæ, &c., as upon measurements which have been shown to vary very widely according to the age and condition (whether recently liberated or not) of the individual.

Placotrochus, M. Edwards and Haime (1848).

The reasons for placing this genus in the family Flabellidæ have been given above.

Placotrochus lævis, M. Edw. and H.—Plate I., fig. 5.

Three specimens from Periya Paar are referable to this species. Two were preserved with the polyps partly extended, one is dead and corroded. The three

specimens vary between the following limits: Height 16 millims. to 12 millims. Calicle from 16 millims. × 7 millims. to 14 millims. × 6 millims. Scar from 6 millims. × 2 millims. to 7 millims. × 2·5 millims. (the smallest specimen has the largest scar). Angle formed by the directive faces of the wall 33° to 40°. They correspond exactly with M. Edwards and Haime's description, except that the directive faces of the wall show only the merest traces of wing-like expansions, in this respect agreeing with Semper's specimens. This appears to be a very rare species. It is remarkable among the Flabellidæ for the perfectly regular development of the septa, the first, second, and third cycles are equal in size, and appear to form with the intermediate quaternary and quinary cycles twenty-four regular systems (Plate I., fig. 5).

Family: FUNGIIDÆ, M. Edwards and Haime.

Fungia (*pars.*) Lamarck.

Fungia danai, M. Edwards and Haime (1851).

Two specimens from the pearl banks, Gulf of Manaar, are referable to this species. The larger specimen is subcircular, measuring 18 centims. × 19 centims., and the central part of the upper surface is raised into a prominent convexity. The smaller specimen has no central prominence, but is evenly convex above and concave below.

Fungia dentigera, Leuckart, 1841.

A single specimen, measuring 16·5 centims. in length, 11 centims. in breadth, and 5·5 centims. in height. According to Döderlein this is a variety of *F. scutaria*, Link, but Gardiner (20) has given a sufficient criticism of this author's varieties.

Locality :—Gulf of Manaar.

Cycloseris, Michelin (*pars.*) **(34).**

Cycloseris cyclolites, Lamarck

Fungia cyclolites, Lamarck, 'Hist. des Anim. sans Vert.,' ii., p. 236, 1816.
Cycloseris cyclolites, M. Edw. and H., 'Ann. des Sci. Nat.,' 3e sér., xv., p. 112, 1851.

Professor Herdman's collection contains thirty-two specimens of this species, twenty-five of which come from the pearl banks in the Gulf of Manaar, four from south of Modragam, one from off Mutwal Island, two from Trincomalee. The range of variation in this species is considerable. In the thirty-two specimens the diameter of the corallum varies from 42 millims. to 27 millims., the height from 19 millims. to 10 millims., the depth of the basal concavity from 9·5 millims. to 1 millim., the length of the fossa from 15 millims. to 6 millims. There is also a considerable amount of variety in the granulation of the costæ, but the septal characters are closely similar in all the specimens.

Cycloseris tenuis, Dana.

Fungia tenuis, Dana, 'Zoophytes,' p. 290, 1846.
Cycloseris sinensis, M. Edw. and H., 'Ann. des Sci. Nat.,' 3e sér., xv., p. 112, 1851.
Cycloseris hexagonalis, M. Edwards and Haime, *loc. cit.*
Cycloseris hexagonalis, Gardiner, Willey's 'Zool. Results. Solitary Corals,' 1899.

Professor Herdman's collection contains seven specimens, of which the largest measures 40 millims. in diameter, while the smaller specimens vary from 22 millims. to 9 millims. in diameter. The smaller individuals, among which are two somewhat hexagonal forms, agree in all respects with the definition of *C. hexagonalis*, M. Edw. and H., and, allowing for individual variation, with Gardiner's excellent photographs of this species (**20**, plate xx.). Two of them have definite basal scars, not yet filled up by secondary deposit, and the costæ reach to the edges of the scars; in the other specimens the costæ, and the extent of the central basal granulation, differ to a considerable extent, but the septal characters are quite uniform and none of the septa are fenestrated. In the largest specimen the two last cycles of septa are fenestrated, a character which would attach it to *C. sinensis*, M. Edw. and H. This species however is synonymous with *Cycloseris* (*Fungia*) *tenuis*, Dana, and the latter name has the priority. Except for the fenestration of the lower cycles of septa there is absolutely no difference between the largest and the smaller specimens in Professor Herdman's collection, hence I am of opinion that *hexagonalis* and *sinensis* are merely varieties of Dana's species *tenuis*, and must be absorbed into it.

Diaseris, M. Edwards and Haime (**37**).

Quelch (**45**, p. 121) has expressed his opinion that the specimens referred to this genus are nothing more than broken and distorted individuals of *Cycloseris tenuis*, but I cannot agree with him. Professor Herdman's collection contains a specimen of *C. cyclolites*, which has been broken and repaired, and shows considerable distortion and re-arrangement of the septa, but its characters are widely different from *Diaseris*. It is true that the structure of the wall, the septa, and even of the rudimentary columella of *Diaseris* are very similar indeed to that of *Cycloseris*, as M. Edwards and Haime pointed out, but the former genus is sufficiently distinguished by its peculiar method of reproduction by radial division, whence the corallum has the appearance of being composed of a number of lobes with rounded edges, or is divided into wedge-shaped fragments. This method of reproduction has been so sufficiently and clearly described by Semper (**49**) that I can add nothing to his account, which is fully borne out by a study of the Ceylon specimens.

Diaseris distorta, Michelin.

Fungia distorta, Michelin, 'Mag. de Zool. V. Zooph.,' pl. 5, 1843.
Diaseris distorta, 'Ann. des Sci. Nat.,' 3e sér., xv., p. 118, 1851.

Numerous specimens and cuneiform fragments from off Mutwal Island, and some small fragments and specimens from deep water off Galle and from Kaltura.

Diaseris freycineti, M. EDWARDS and HAIME (**37**).

A number of petaloid fragments from the Gulf of Manaar and from off Kaltura appear to belong to this species. As described by M. EDWARDS and HAIME, the septa are of less height, much more closely packed, and have thicker edges than in *D. distorta*. I may add that all the septa are more or less fenestrate. The spirit specimens are of a rich red-brown colour, the upper surface exhibiting black spots near the inner ends of the septa. These spots probably indicate the position of the tentacles, but the specimens are so contracted that I cannot speak with certainty on this point.*

FAMILY: EUPSAMMIIDÆ.

As SEMPER has remarked (**49**, p. 256), the difficulty of determining the species and even the genera of the Eupsammiidæ is very great. In order to relieve himself of the difficulty, he founded the genus *Rhodopsammia* to include his Philippine specimens, and the genus has been accepted by most subsequent authors, even by DUNCAN in his critical revision of the genera of the Madreporaria, and this in spite of the fact that, as I shall show, SEMPER's genus was confessedly provisional.

SEMPER's definition of the genus *Rhodopsammia* runs as follows:—"Polypary simple or with lateral buds, free or attached, sometimes cylindro-conical, sometimes compressed (not, as DUNCAN gives it, 'Corallum simple or colonial, free or attached, with lateral buds'). Epitheca absent or rudimentary. Costæ simple, visible from the base upwards, similar, thickly granulated. Calicular fossa rather deep, with a more or less prominent columella consisting of curled leaflets (aus gewundenen Blättchen). The septa narrow, with sharp edges, scarcely rising above the lip of the calice: those of the first cycles equal, extending right down to the columella; those of the third cycle smaller, and also united to the columella; the septa of the remaining—often irregular—cycles much narrower and invariably united to those of the preceding cycle."

This definition differs from M. EDWARDS and HAIME's description of any genus of Eupsammiidæ, as it includes both single and compound, free and attached, forms, but it embraces all members of the genera *Eupsammia*, *Balanophyllia*, *Leptopsammia*, and *Endosammia*, and possibly some species of the genus *Dendrophyllia* as defined by the authors of the 'Histoire Naturelle des Coralliaires,' and it is quite clear, from what SEMPER says, that he meant at least the first four of these genera to be included in his new genus. Thus (*loc. cit.*, p. 256) he says: "Da mir nun leider das fossile Material fehlt, welches nöthig wäre, um diese Incongruenzen gründlich ausgleichen zu können, so ziehe ich es vor, hier die von mir bei Bohol aufgefundenen 8 Arten ohne

* Professor HERDMAN's "Field-notes" contain the following colour record of this species when alive:—Station XLIII., off Kaltura, 22 fathoms, "also a living group of four 'flabellums' having upper side dark purple on the outer margin and dark green within, mottled with paler yellowish-green, grey, and deep drab-purple, the septa especially being of the latter colour—the under side is white." The accompanying sketches show that the Coral is a *Diaseris*.

Rücksicht auf ihre Basis als Species einer neuen Gattung zu beschreiben, wobei ich es Anderen überlassen muss, die schon beschriebenen lebenden und fossilen Eupsammidæ nach den durch die philippinischen Formen sich ergebenden Andeutungen zu untersuchen, und mit diesen in systematischen Zusammenhang zu stellen." Notwithstanding SEMPER'S hope that one of his successors would show the proper systematic relation between his Philippine specimens and previously described fossil and living forms, DUNCAN, in his 'Revision of the Madreporaria,' retains SEMPER'S genus *Rhodopsammia*, but removes it from the "alliance" Balanophylloida, to which, on its author's own testimony, it belongs, and places it apart as a genus which cannot be included in any alliance!

The Eupsammiidæ in Professor HERDMAN'S collection include free and fixed, solitary and colonial forms, and most of them resemble one another very closely in such distinctive characters as septal arrangement, columella, and costæ. The solitary forms (with the exception of *Heteropsammia*) must, without doubt, be referred to a single genus, and they agree in all respects with SEMPER'S definition of the genus *Rhodopsammia*. But if we agree with SEMPER and ignore, as we must after the study of a sufficient number of specimens, such variable characters as attachment or its contrary, the presence or absence or the completeness or incompleteness of a fifth cycle of septa, or the relative thickness of the septa, we must recognise that the genus *Rhodopsammia*, SEMPER, includes *Eupsammia*, M. EDWARDS and HAIME; *Balanophyllia*, SEARLES WOOD; *Leptopsammia*, M. EDW. and HAIME; *Endopsammia*, M. EDW. and HAIME, and it becomes a question as to what name shall be used to denote the single genus into which all the other genera are absorbed. The genus *Balanophyllia* was founded by SEARLES WOOD in 1844, and there is no objection to be taken to it on the score of indefiniteness. Therefore, by the rules of nomenclature, it has the priority over the genera founded by M. EDWARDS and HAIME in 1848, and *à fortiori* over SEMPER'S genus *Rhodopsammia* founded in 1872. Hence I suggest the amendment of the definition of *Balanophyllia* in the terms of SEMPER'S definition of *Rhodopsammia*, the latter name being dropped and *Eupsammia*, *Leptopsammia*, and *Endopsammia* merged into *Balanophyllia*.

It is a characteristic, though not a peculiarity of the Eupsammiidæ, that the septa of the later cycles curve towards and are usually united to those of the preceding cycle, and it commonly happens that the septa of what on the ordinary system of reckoning would be called the last cycle are larger than those of the preceding cycle. SEMPER, many years ago (**49**, p. 259), called attention to the inapplicability of M. EDWARDS and HAIME'S law of septal sequence to the Eupsammiidæ as well as to other Madreporaria described in his well-known memoir, but until recently there has been no satisfactory explanation of the apparent irregularity in the septal sequence of these forms, and it has been necessary, in spite of its obvious disadvantages, to retain M. EDWARDS and HAIME'S system of notation in describing the septa of all Madreporaria. But as long ago as 1871, POURTALÈS (**43**) gave a description of the

development of *Balanophyllia floridana* which, if it had received the attention it deserved, would have given a full explanation of the peculiarities of the septal arrangement in this genus. POURTALÈS' description is as follows: "The youngest individuals observed have the shape of a truncated cone attached by the base. The wall is quite smooth, imperforate, and the septa, twelve in number, equal and not quite extending to the centre, where the rudiments of the columella are already visible. . . . . The next step is the formation of costæ on the upward prolongation of the wall. They first appear in the shape of sharp points grouped about the origin of the septa. At the same time an opening appears on the border and rather outside of the calicle, opposite each of the secondary septa, which gradually widens inwards, apparently dividing the septum in two. The two borders of that opening become the tertiary septa; the secondary septum is gradually pushed inwards and is replaced by a new one growing out on the same radius from the wall, and but loosely connected with the jointed tertiaries and original secondary. . . . . The interior part of the tertiary septum is now to all intents and purposes a palus. . . . . As the growth proceeds the point of junction of the tertiaries and secondaries moves further into the calicle until it reaches the columella. At this period the older or internal part of the secondary septum has nearly entirely disappeared and the same process of growth goes on with the septa of the fourth cycle which become joined to those of the third." In these few sentences POURTALÈS anticipates the discoveries of several recent authors. The imperforate wall is clearly the basal plate of VON KOCH (= prototheca, BERNARD). The description of the formation of costæ on the upward prolongation of the prototheca agrees exactly with DE LACAZE DUTHIER'S description and figures of the development of these structures in *Balanophyllia regia* (**33**, plate x., figs. 20 and 21). The description of the bifurcation of the peripheral ends of each secondary septum, and the formation of a new secondary septum on the same radius, is in exact agreement with DUERDEN'S (**9** and **10**) account of the septal sequence in *Siderastræa radians*. But, although the credit of priority must rest with POURTALÈS, it is the last-named author who has given a full and perfectly intelligible account of this mode of septal sequence, and has shown in detail the relation between the order of appearance of the septa and that of the mesenteries. In his valuable and beautifully illustrated memoir, DUERDEN has shown that in *Siderastræa radians* the six septa comprised in the first cycle appear simultaneously, and are situated within the entocœles of the six primary pairs of mesenteries. The six septa of the second cycle make their appearance later and occupy the six exocœlic chambers, thus alternating with the six primaries. As growth proceeds the peripheral ends of all the septa become bifurcated, as a consequence of the continuous addition of skeletal nodules to their outer ends, but the angle formed by the bifurcating limbs is much larger in the secondary (exocœlic) than in the primary (entocœlic) septa. The bifurcations become filled up and disappear in the primary septa, but in the secondaries they continue to extend, and presently a second mesenterial cycle is developed, each

mesenterial pair being situated within the angle formed by the bifurcated peripheral extremities of the secondary septa. After a time a new cycle of entocœlic septa is formed, each septum within a mesenterial pair of the second cycle, and as growth proceeds these secondary entocœlic septa grow centripetally, and fuse with inner portions of the septa which originally constituted the exocœlic cycle. Thus a stage

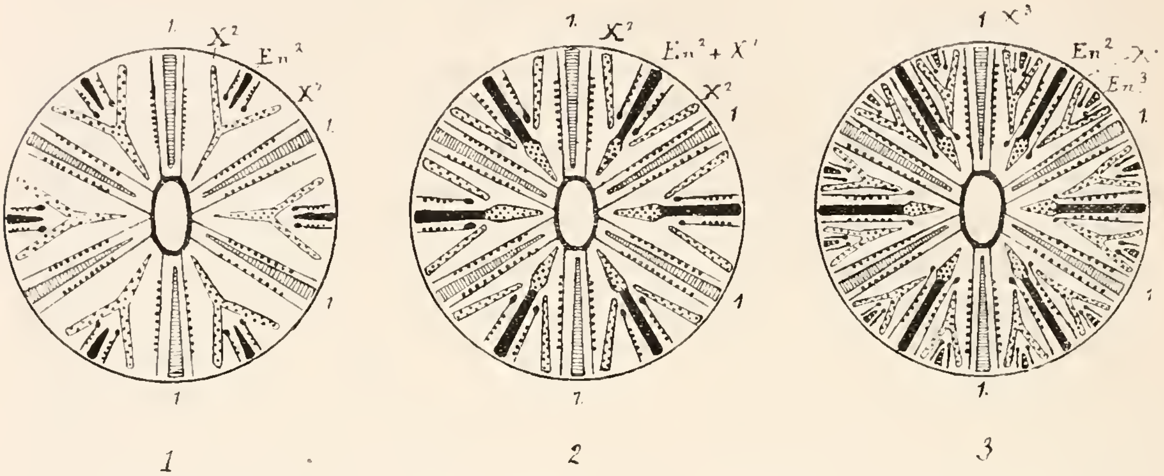

Fig. I. Diagram illustrating the development of the septa, and their relation to the mesenteries in *Balanophyllia floridana* (POURTALÈS), and *Siderastræa radians* (DUERDEN). The primary entocœlic septa are shaded with cross lines; the exocœlic septa are dotted; the secondary entocœlic septa are black; the tertiary entocœlic septa are banded black and white. In fig. 1 the outer ends of the six exocœlic septa have bifurcated to form the secondary exocœlic septa X^2; within each bifurcation a new mesenterial cycle of the second order has been formed, embracing an entocœlic septum of the second order $En.^2$. In fig. 2 the secondary entocœlic septa have grown inwards and fused with the inner limbs of the first formed exocœlic septa, thus forming the *apparent* second cycle of septa $En.^2 + X^1$. In fig. 3 the secondary exocœlic septa X^2 have in turn bifurcated, and in each of the twelve bifurcations a mesenterial pair of the third order is developed, embracing a tertiary entocœlic septum $En.^3$. The primary entocœlic septa are denoted by 1, 1 in all the figures.

is reached in which there are three cycles of septa; two cycles, namely those which are ordinarily reckoned as the first and second, are entocœlic, the remaining cycle, which would ordinarily be reckoned as the third, is exocœlic. But it is clear that each apparently secondary entocœlic septum is a compound structure, its inner end formed of a septum which was actually second in order of appearance, its outer end of a septum which was actually third in order of appearance. And it is further clear that the exocœlic septa, which appear to constitute the third cycle, are really the forked peripheral ends of the septa that were second in order of appearance. The formation of the next cycle of mesenteries and septa follows the same rule. The exocœlic septa become bifurcated at their extremities; new mesenterial pairs of the third cycle are formed within the bifurcations; a new cycle of entocœlic septa is formed within the pairs of third-cycle mesenteries, and these grow centripetally and unite with the inner limbs of the apparently third-cycle septa of the previous

stage, the bifurcated outer ends of these same septa constituting the apparent fourth cycle. The further development has not been followed, but it probably continues on the same plan. Thus it appears, as is shown in the diagram above, that at any given stage in the growth of the coral, all the entocœlic septa, after the first cycle, are composite structures, but all the exocœlic septa, forming the apparently last cycle, are the derivatives of the original exocœlic septa which were second in order of appearance. One can scarcely imagine anything more at variance with M. EDWARDS and HAIME's law of septal sequence. DUERDEN has further shown that there is a regular dorsi-ventrality in the mesenterial, and therefore in the septal succession of *Siderastræa radians*. New mesenterial pairs appear first in the dorsal member of the two exocœles of each system. This fact may be of assistance in explaining the irregularities in the apparently last cycle of septa which are so common in the Eupsammiidæ and other corals, but, as I shall show, the same sequence does not seem to obtain in *Balanophyllia* as in *Siderastræa*, and it is quite probable that the dorsi-ventral order of the appearance of the mesenteries varies as much in the Scleractiniæ as it does in the Malakactiniæ.

The convergence and union of the inner ends of the lower orders of septa is a much more common phenomenon than is generally supposed. In the collection of corals forming the subject of this paper, such septal unions occur in *Rhodocyathus*, *Heterocyathus*, and *Paracyathus* among the Turbinolidæ. They are characteristic of the genera *Cycloseris* and *Diaseris*, and, as I have shown elsewhere (**6**), they are well marked in the anthoblast of *Fungia*. But they are above all characteristic of the Eupsammiidæ, in which the septal arrangement of the adult appears to retain its embryonic character, and it may be inferred from the septal characters of the adults that the septal sequence in the course of development has followed the law of POURTALÈS and DUERDEN. It is obvious that, if this inference is correct, all the adult septa of the apparently last cycle will be exocœlic, while those of the apparently penultimate cycle will be entocœlic and contained within the mesenterial pairs of the last formed, and therefore smallest, mesenterial cycle. In the second part of this paper I shall show that this is the case, not only in *Heteropsammia* and a species of *Dendrophyllia*, among the Eupsammiidæ, but also in *Heterocyathus* among the Turbinolidæ.

It might seem desirable to amend MILNE-EDWARDS and HAIME's method of enumerating the septa, and to adopt a system more consistent with the facts of developmental sequence as now ascertained. But after several attempts to invent a new notation, I have decided to retain the old method. After all, we have only POURTALÈS' and DUERDEN's accounts to go by, and we are by no means certain that what is true of the species they describe is true of all Madreporaria. Future researches may bring to light considerable differences in the septal sequences of different groups, and it would be premature to invent a system of notation that might prove to be inapplicable to new cases. I have therefore retained the old system in describing the

Eupsammiidæ in Professor HERDMAN'S collection, leaving it to be understood that the words "secondary," "tertiary," &c., indicate only the size of the septa, and not their order of succession. And in this connection it may be noted that DE LACAZE DUTHIER'S account (**33**) of the septal succession in *Balanophyllia regia* differs widely from that of POURTALÈS' account of *B. floridana*, and therefore from DUERDEN'S. I am inclined to think, however, that DE LACAZE DUTHIERS missed the actual succession of the development of the septa. An inspection of his figures (Plate x., figs. 23 and 29) will show that they are not inconsistent with DUERDEN'S and POURTALÈS' accounts. In fig. 23, the septa marked 2 are clearly bifurcated at their distal ends, and the sclerite lying within each bifurcation gives every appearance of having been formed independently and having become secondarily united with the inner limb of the bifurcated secondary. In fig. 29 the septum marked 3 is equal in size to, and clearly continuous with, the inner end of the septum marked 2, the latter thinning out very much towards its point of union with the angle of the **Y**. And in the same figure the "tertiary" septum occupies the position of a "quaternary," and the septa that occupy the positions of "tertiaries" are described as subsequent formations. They are clearly the new entocœlic septa formed between the bifurcated peripheral ends of the exocœlic septa marked 3.

Balanophyllia parallela, SEMPER—Plate I., figs. 6 and 6A.

Rhodopsammia parallela, SEMPER, 'Zeit. für Wiss. Zool.,' xx., 1872.
Rhodopsammia parallela, FOWLER, 'Quart. Jour. Micr. Sci.,' xxv., new ser., 1885.

A single specimen from the pearl banks, Gulf of Manaar. Height of corallum 29 millims.; longer axis of calice 18 millims.; shorter axis 13 millims.; depth of calice 8 millims. In this specimen the outline of the calice is not so hexagonal as in the Philippine form described by SEMPER, and the base is narrow and pedicellate, whereas the Philippine forms are free and pointed below. Septa in six systems and five cycles, the fifth cycle being incomplete. The primary and secondary septa are equal in size, similar and somewhat exsert; their outer ends are thickened and porous, their inner ends sharp, entire, and descend nearly vertically to unite with the columella; their sides are ornamented with radiating rows of very small granules; their upper ends more or less fenestrate. The tertiary septa are smaller and their inner ends become thickened and trabecular and pass into the columella; each is joined at two-thirds of its length from the lip of the calice by the quaternary septa. There is an incomplete cycle of quinary septa, which can best be described by saying that the peripheral ends of the quaternaries bifurcate and a small septum is developed between their bifurcated ends in each directive moiety of the four primary systems adjoining the directive septa, and the same arrangement is present in all but one of the four outer moieties of the same systems. The quaternary septa are not bifurcated in the lateral primary system on one side of the coral, and on the other side only one is bifurcated and contains an entocœlic septum in each of the moieties of the system.

In other words, the formation of a new cycle of entocœlic septa has progressed more rapidly at the two directive ends than at the sides, and the sequence is therefore different from that observed by DUERDEN in *Siderastræa radians.*

This specimen is in many respects intermediate between SEMPER'S *Rhodopsammia carinata* and *R. parallela*, and I am inclined to think that these two and *R. amœna* are only varieties of one species. The Ceylonese specimen agrees with *R. parallela* in having vertical inner edges of the primary and secondary septa, in the costæ being of equal size, in the presence of a fifth incomplete cycle of septa, and in the depth of the fossa. In all these respects it differs from *carinata*, but such characters are clearly variable. The calice is less compressed and more regularly oval than in SEMPER'S figures of *parallela*, but FOWLER **(14)** gives a figure of the calice of this species in which the difference between the longer and shorter axes is even less than in the specimen here described, and the septal arrangement is almost identical.

Balanophyllia cumingi, M. EDWARDS and HAIME **(36)**—Plate II., figs. 7 and 7A.

Rhodopsammia ovalis, SEMPER, 'Zeit. für Wiss. Zool.,' xxii., p. 262, 1872.

There are three specimens in Professor HERDMAN'S collection, of which one, from deep water off Galle, so closely agrees with M. EDWARDS and HAIME'S description and figure of *B. cumingi* that I have no hesitation in referring it to this species. It is somewhat larger than the type specimen (the height being 12 millims., the calice 19 millims. × 12 millims.) and the fifth cycle of septa is well developed and nearly complete. The second specimen is from Trincomalee and is a small colony, or rather an aggregation consisting of three dead and decayed corallites, one small and one large living corallite. Of the living corallites the larger measures: height 30 millims., calice 19 millims. × 12 millims., depth of calice 12 millims. Smaller corallite: height 12 millims., calice 8 millims. × 6 millims., depth of calice 5 millims. The larger corallite is identical with the specimen of *B. cumingi*, from Galle, in septal characters, the columella, and the costæ, differing from it only in being longer and turbinate in shape with a narrow base, whereas the Galle specimen is short with a broad base. The septal arrangement is shown in fig. 7A, and it agrees very exactly with SEMPER'S description of *Rhodopsammia ovalis.* The tertiary septa are continued below into the columella, but, as the figure shows, their lower ends converge distinctly towards the secondary septa. The "quaternaries" are inserted very low down on the tertiaries and the quinary cycle is nearly complete, but in the two lateral systems three of the quaternaries adjoining the secondary septa are not bifurcated, nor is the quaternary adjoining a secondary in one of the remaining systems. The smaller corallite in the Trincomalee specimen has a nearly circular calice. The six primary septa are conspicuously larger than the others and pass straight to the columella. The secondary septa are joined just above the columella by the "tertiaries," and the latter bifurcate in all but two instances and a new cycle of entocœlic septa is formed in the bifurcations. This shows that the secondary septa have been formed in the

manner described by POURTALÈS and DUERDEN, and that it is only at a later stage of growth that the extension of the columellar trabeculæ overspreads the union of the tertiaries with the secondaries and causes the latter to appear as if they sprung directly from the columella. The primary and secondary septa are much thickened and porous towards their thecal ends.

Balanophyllia socialis, SEMPER.—Plate II., figs. 8 and 8A.

Rhodopsammia socialis, SEMPER, 'Zeit. für wiss. Zool.,' xxii., p. 260, 1872.

A beautiful cornuate specimen from the pearl banks, Gulf of Manaar, clearly belongs to this species, as is shown by its subcircular calice, deep fossa, well-developed and projecting columella, and four fully developed cycles of septa. Its measurements are: height 27 millims.; calice 10 millims. × 9 millims.; depth of calice 6 millims. There are no buds, but a small outgrowth of the theca 3 millims. below the lip of the calice on the opposite side to that drawn in fig. 8 is evidently the commencement of a bud. The primary and secondary septa are equal in size, as described by SEMPER, and their surfaces are covered with very fine granules ("äusserst fein gekörnelt"), but they are only very slightly thickened peripherally, and in this respect resemble *Rhodopsammia affinis*, which, as SEMPER himself says, is probably nothing more than a variety of *R. socialis*. *R. dubia* and *R. incerta*, both SEMPER, again are almost certainly nothing more than varieties of the same species. SEMPER describes the quaternary septa as uniting with the tertiaries close to the columella. In the Ceylonese specimen, as is shown in fig. 8A, the quaternaries do not invariably unite with the tertiaries, and indeed they follow M. EDWARDS and HAIME'S law very closely, the quaternaries nearest the primary septa being, as a rule, the best developed. The infrequent union between the third and fourth cycle septa, however, does not indicate that the septa have not been developed according to POURTALÈS' and DUERDEN'S law, for the latter author shows (**10**, p. 103, fig. 12, *c*) how the bifurcated external limbs of the lower cycles of septa commonly become detached from the inner limb.

A dead and corroded specimen from deep water off Galle seems to belong to this species. The calice was broken so much that its characters were indistinguishable, but a section taken lower down shows that it is peculiar in having a tetrameral instead of a hexameral arrangement. There are four systems: the primary septa are the largest, the secondaries are smaller, but pass direct to the columella, the tertiaries also join the columella, but converge in a marked manner towards the secondaries, and there is a complete fourth cycle uniting with the tertiaries. There is no indication of this arrangement being derived from an originally hexameral arrangement, and it must be regarded as a remarkable variation from the normal.

Balanophyllia taprobanæ, n. sp.—Plate II., figs. 9 and 9A.

Height of corallum 15 millims.; calice 6 millims. × 5 millims.; depth of calice,

3 millims. The six primary septa are much larger than the others, considerably thickened at their thecal ends, and they, and the two septa adjacent to them, are exsert, forming a crown of six prominent points round the edge of the calice. The edges of the primary septa slope rather steeply inwards and then descend vertically into the depth of the fossa without joining the columella; the inner half of the surface of each primary septum is nearly smooth, the outer half bears a number of spinose granules. There are five septa of lower orders in five of the systems and seven in the sixth system (adjoining one of the directive septa), those adjacent to the primary septa being the largest and most exsert; the smaller septa join the columella very deep down in the fossa. Costæ of the six primary septa larger and more prominent than the rest, forming ridges extending nearly half-way down the corallum; the remaining costæ subequal, extending to the base, the perforations between the costæ numerous and relatively large. Columella oval, very prominent, spongy in texture. Buds are formed on opposite sides a little way below the margin of the calice, each bud being astride of a primary costa.

A single specimen from deep water off Galle.

I have founded this species to receive a small and remarkably beautiful coral, which resembles *B. rediviva*, MOSELEY, in the costæ and arrangement of the septa, but differs from it in size, in colour (*B. rediviva* is "reddish coloured," *B. taprobanæ* a brilliant white), and in the fact that the secondary septa are not exsert. These differences can hardly be due to immaturity, as the specimen of *B. taprobanæ* bears two fairly advanced lateral buds.

The septal characters are particularly interesting as being wholly unintelligible unless interpreted in the light of POURTALÈS' and DUERDEN'S work. In fig. 9A it is evident that, in the lateral system on the left hand of the drawing, the inner ends of the septa marked $X.^2$, $X.^3$, are the bifurcated arms of the exocœlic septa of the cycle second in order of appearance; these arms unite together and with the columella very low down in the calice. The septum marked $En.^2$ is clearly the entocœlic septum of the cycle third in order of appearance. In the upper half of the system the exocœlic septum has bifurcated to form the secondary exocœlic septa $X.^3$, $X.^3$, and a new entocœlic septum $En.^3$ is formed in the bifurcation. A precisely similar arrangement obtains in four of the remaining systems, and in each it is the upper member of the exocœlic septa that has bifurcated, giving a dorsiventral arrangement entirely consistent with DUERDEN'S description of the septal succession in *Siderastræa radians*. In the left-hand lower terminal system both exocœlic members have bifurcated and an entocœlic septum is present within each bifurcation. In *B. rediviva* all the systems are similar to this single system in *B. taprobanæ*, and the arrangement would obviously be that which is normal in the Eupsammiidæ, if it were not for the preponderant size of the apparent quaternaries, whose outer ends become more or less intimately united to the primary septa. The condition in *B. taprobanæ* is a step towards the septal arrangement in *B. verrucaria*, PALLAS, and *B. cornu*,

MOSELEY. SEMPER (**49**, p. 263), in discussing the validity of his genus *Rhodopsammia*, makes reference to the difference in the septal characters of the former species as shown in MILNE-EDWARDS and HAIME'S figure (**36**, plate i., figs. 6, 6A), but it requires no great amount of ingenuity to show that the difference, great as it may appear at first sight, is really nothing more than a slight variation of the grouping of septa developed according to the sequence established by POURTALÈS and DUERDEN.

It is possible that the specimen here referred to *Balanophyllia*, is nothing more than the initial individual of a colony of *Dendrophyllia*, and the two lateral buds lend some support to this view. On the other hand, the buds, both from their position and character, might very well be similar to those of *B. socialis* or *parallela*, and as the specimen is a solitary one, I have preferred to refer it, provisionally, to the same genus.

Lobopsammia, M. EDWARDS and HAIME (**36**).

The small colony shown in Plate II., fig. 10, agrees very closely with the definition of this genus, hitherto represented only by fossil forms. The structure of the corallites, however, is so similar to that of *Balanophyllia cumingi* that it is hard to draw any distinction between them; the septa and columella are almost identical, and the most that can be said is that the costæ are smaller and the theca decidedly thinner than in the latter species. If this specimen must be separated from *Balanophyllia* on account of its colonial habit, it must be placed with *Lobopsammia* rather than with *Cœnopsammia* because of its elliptical calices and because the mode of aggregation of the colony suggests that it has been formed by fissiparity rather than by gemmation. Moreover, its likeness to *L. cariosa*, GOLDFUSS (**25**, taf. xiii., fig. 7), is sufficient to establish its generic position.

Lobopsammia robusta, n. sp.—Plate II., figs. 10 and 10A.

Colony consisting of a few corallites borne on a very thick and short stem. The individual corallites short, radiating outwards from the stem. Calices oval, somewhat irregular in outline; calicular fossæ deep; columella spongy, with a flat upper surface, not projecting into the calice. Five cycles of septa; the primaries and secondaries subequal, not exsert, with nearly vertical inner edges. The quaternaries are united with the tertiaries near the columella; the fifth cycle is complete except in the lateral systems, and the quinary septa unite with the quaternaries high up in the calice; the lower orders of septa fenestrate with serrated or denticulated margins. Costæ fine, of equal size, extending to the base of the stem.

Height of colony 27 millims.; the largest calice measures 15 millims. × 11 millims.; depth of calice 7 millims.; smallest calice 11 millims. × 8 millims.

A single specimen from deep water off Galle.

Dendrophyllia, DE BLAINVILLE ('Dict. des. Sci. Nat.,' lx., p. 319, 1830).

Dendrophyllia gracilis, M. EDWARDS and HAIME (**36**).

A portion of a colony, from deep water off Galle, appears to belong to this species. The fragment only included three mature corallites, two of which, with the buds attached to them, were decalcified for the study of the soft parts. The remaining corallite is somewhat broken, but the size, septal characters and mode of budding appear to be those of *D. gracilis*.

Dendrophyllia minuscula, n. sp.—Plate II., figs. 11 and 11A.

Colony arborescent; the trunk and branches slender; the lateral corallites disposed in alternate and opposite pairs. Costæ of equal size, rather prominent, finely granulated. Calice circular, with a fairly deep fossa. Columella formed of a few calcareous trabeculæ, moderately prominent in the fossa. Septa in six systems and three cycles, with traces of a fourth. The primary septa exsert, forming a crown of six points at the edge of the calice. The apparent tertiary septa next in size closely applied to the primaries at their outer ends, their inner ends converging and uniting deep in the calice just before joining the columella. The apparent secondaries short, usually not united to the inner ends of the tertiaries. Height of colony 25 millims.; diameter of calices 2 millims.

A single small colony and a fragment of this very elegant species from deep water off Galle. The large exsert primary septa recall those of *Balanophyllia taprobanæ*, but the corallites are much smaller, the primary costæ are not prominent, and there are three cycles of septa with traces of a fourth in one system only, in the corallite depicted in fig. 11A. This figure shows very clearly that the apparent tertiaries are the exocœlic bifurcated ends of the original secondary cycle, and that the apparent secondaries are the entocœlic septa formed in the angles of the secondaries, and, therefore, are the third cycle in order of appearance.

Heteropsammia, M. EDWARDS and HAIME (**36**).

Heteropsammia michelini, M. EDWARDS and HAIME (**36**).

Numerous specimens from nearly all stations. The septal arrangement and anatomy of this genus are fully described in the second part of this paper.

PART II.—ANATOMY.

1. Heterocyathus æquicostatus, M. EDWARDS and HAIME.

(Plates III. and IV., figs. 12 to 21.)

GARDINER (**23**) has given a short account of the anatomy of this species, but he does not deal with the minute structure of the corallum, and I am able to supplement his description of the anatomy of the polyp in many particulars.

The Corallum.—In the majority of specimens there are forty-eight septa, which, according to MILNE-EDWARDS and HAIME'S system of notation, would be described as being regularly arranged in six systems and four cycles. It will become obvious, however, that the septa have been developed according to DUERDEN'S and POURTALÈS' law, and that what are apparently the quaternary septa are really exocœlic septa belonging to the second cycle in order of appearance. In some few specimens the normal regularity of the septal arrangement is disturbed by the development of one or two additional septa in one or more of the systems. These additional septa are always inserted between the apparent tertiaries and the apparent quaternaries adjacent to them, and suggest the commencement of a fifth septal cycle, but in every system in which they occur there is so much irregularity in the septal arrangement that I attribute their presence to a process of re-growth and repair rather than to the formation of a new cycle. The normal arrangement of the septa is shown in fig. II. There are three cycles of endosepta. The six primaries are prominently exsert and their inner ends bear large paliform lobes just before they unite with the columella. The secondary endosepta are likewise prominent and exsert, and there are two or three prominent vertical pali at the inner extremity of each. The innermost of these pali can with difficulty be distinguished from the vertical upgrowths of the columella, and the outermost is fused to the inner free margin of the septum, so that there is a transition between "true pali" and "paliform lobes." I am inclined to think that the sharp distinction drawn between these paliform structures is artificial and untenable. The inner ends of the third cycle of endosepta converge towards the secondaries and unite with them just outside the columella through the intervention of palial upgrowths. In specimens that have been rubbed down, the pali in front of the secondary and tertiary septa are seen to unite to form a chevron, similar to the chevrons characteristic of *Deltocyathus*.

Between every two endosepta there is an exoseptum, and in the deeper parts of the corallum, *i.e.*, below the level of the exsert portions of the septa, these exosepta are seen to be united to the adjacent endosepta by tangential bars which, although they do not exactly correspond to the similarly named structures of the Fungiidæ, must be described as synapticula. Their arrangement is very regular and characteristic. Each primary endoseptum is joined to the exoseptum on either side of it by a synapticulum which curves downwards and inwards to the fossa. These primary synapticula, as they may be called, are equidistant from the centre of the coral, and are situated nearer the centre than the others, so they form a sort of inner synapticular ring. Each secondary endoseptum is similarly joined to the two adjacent exosepta by synapticula which are situated somewhat further from the centre than the primary synapticula, and similarly the tertiary endosepta are joined to the adjacent exosepta by synapticula still further from the centre and forming an outer ring. Thus there is only one synapticular bar in each interseptal loculus. In longitudinal section the synapticula are seen to be narrow curved bars or partitions, in shape and

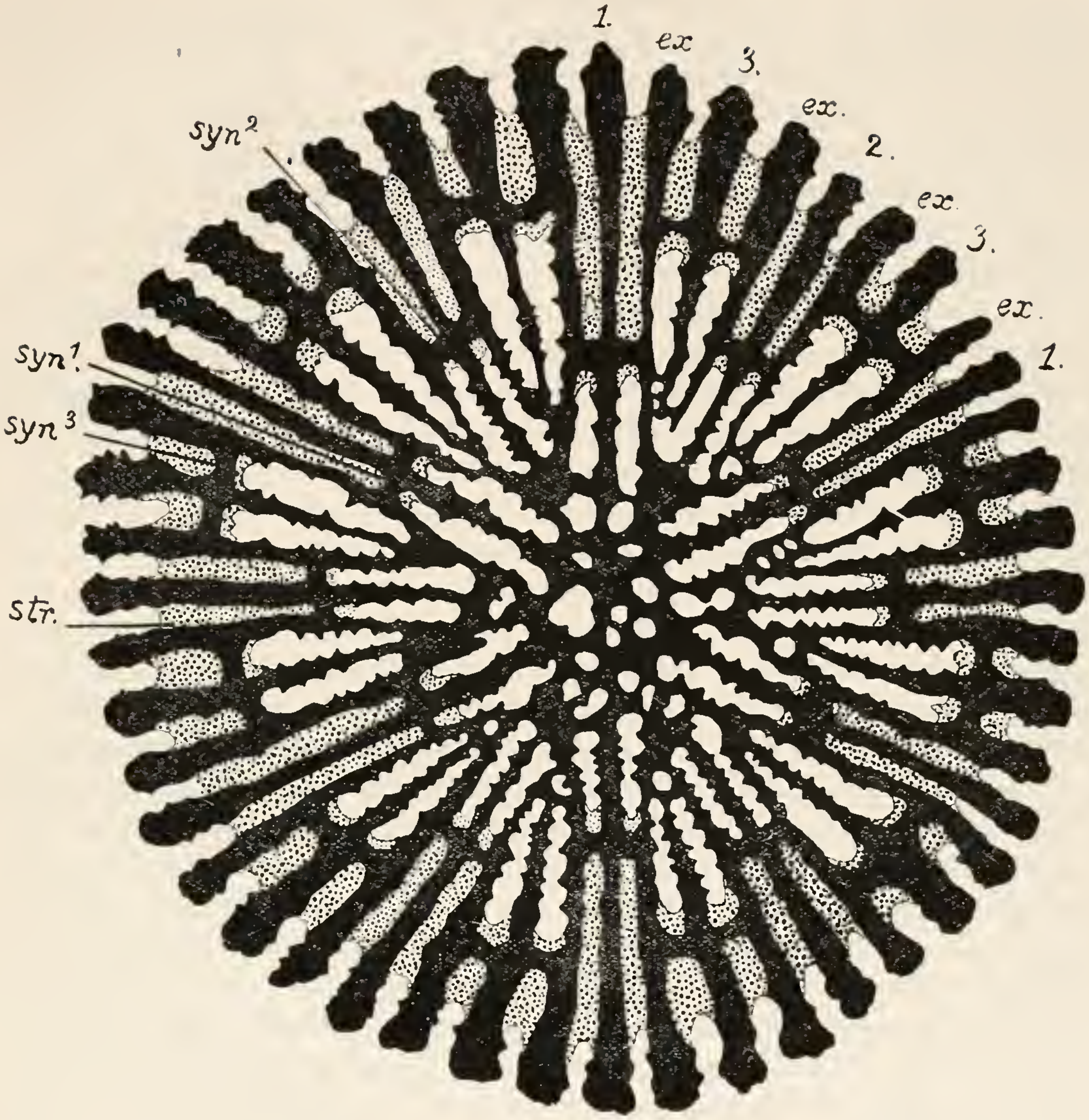

Fig. II. Diagram of a section through the corallum of *Heterocyathus aequicostatus* taken a short distance above the *Aspidosiphon* chamber. The septa and synapticula are black, the stereoplasm is shaded with dots. 1, 2, 3, endosepta of three cycles. *ex.*, exosepta. *str.*, stereoplasm. *syn.*[1], synapticulum connecting a primary endoseptum with an exoseptum. *syn.*[2], *syn.*[3], synapticula connecting secondary and tertiary endosepta with adjacent exosepta.

structure resembling any single synapticulum of *Fungia*. Their lower ends pass into the secondary calcareous deposit in the neighbourhood of the *Aspidosiphon* chamber; their upper extremities end in free margins at heights varying according as they connect a primary, a secondary or a tertiary endoseptum with an adjacent exoseptum.

The exosepta, in addition to this synapticular union, converge towards, and their inner ends unite with, the tertiary endosepta.

In the upper parts of the corallum the synapticula form the only union between adjacent septa, but a little distance lower down, and at some height above the *Aspidosiphon* chamber, the interseptal loculi become largely filled up by a secondary calcareous deposit, which, being of a dark colour from the presence of an abundant brown pigment, stands in sharp contrast to the white septa and synapticula in a rubbed down specimen. This deposit is crystalline in structure, and as it appears to have been formed independently of and subsequent to the original septa and synapticula, it has all the characters of a "stereoplasm," *i.e.*, a thickening on either side of every septum filling up the interseptal loculi. It should be observed that this deposit is most abundant and extends furthest towards the centre in the interseptal loculi adjacent to the primary endosepta; it is abundant, but does not extend so far towards the centre in the loculi adjacent to the secondary endosepta; it is least abundant in the loculi adjacent to the tertiary endosepta (fig. II.).

The structure of the septa is somewhat complicated, and different to anything that has hitherto been carefully figured or described. Each septum is very thin at its inner end and gradually thickens towards its outer or costal extremity. As is shown in Plate III., fig. 12, its inner edge is produced into a number of irregularly shaped teeth or paliform lobes, which merge into the columella, and the impossibility of distinguishing between these paliform septal offsets and true pali has been alluded to above. The faces of the septa are covered with small spiniform granulations which seem to radiate from a centre situated just within the lower end of the synapticulum. These spiniform granules are shown by longitudinal, horizontal and tangential sections to be the extremities of the radiating trabeculæ (using this term in PRATZ's sense) of which the septum is composed. Plate III., fig. 13, is a careful drawing of a horizontal microscopical section through the middle of the corallum, above the level of the *Aspidosiphon* chamber. The thin inner ends of the septa are shown to consist of a series of trabeculæ, standing in a single line, but at intervals diverging from the centre to end in a spiniform granule on the septal surface. Passing from the centre towards the periphery, the thickening of the middle and outermost parts of each septum is seen to be due to the multiplication of the trabeculæ, which no longer form a single line but stand in rows, first two, then three, and finally, at the costal extremity, five or six deep. It can be seen clearly enough in the horizontal section that these trabeculæ radiate not only towards the central and the peripheral ends of each septum, but also outwards towards the two septal surfaces, on which they emerge as the spiniform granules already described. The septum, then, is formed of a number of trabeculæ which radiate in all directions from an imaginary centre situated low down and nearer to the inner than the outer (costal) margin of the septum, and it is apparent that the centrifugal growth of the septum is effected by the addition of new trabeculæ on the outside of those first formed, these new trabeculæ being at first in single series, but in the more peripheral parts becoming arranged in curved rows, two, three, and more abreast. The curved growth lines,

showing the successive additions to the septum, and their relations to the rows of trabeculæ, are well shown in the figure, as well as the way in which the outermost trabeculæ in each row from place to place bend sharply towards the surface and end in a spiniform granule.

It will be observed that there is no dark central line and no dark "centres of calcification." The centre of each trabecula is clearer than the surrounding calcareous deposit, and the latter, which appears white by reflected but dark by transmitted light, seems to have a very fine fibrous rather than a crystalline structure, but I could not make out the details clearly in the thinnest sections that I was able to prepare. In longitudinal sections each septum is clearly seen to be made up of a number of trabeculæ radiating like a fan from a centre, and each trabecula appears to be made up of a number of growth segments joined end to end, each segment formed by the fascicle of diverging fibres described by PRATZ and Miss OGILVIE as characteristic of the minute structure of the Madreporarian corallum.

But if no definite crystalline structure can be discovered in the septa themselves, or in the synapticula, the case is different for the "stereoplasm" in the interseptal loculi. This stereoplasm, except where it is heavily charged with brown pigment, appears dark by reflected and light by transmitted light, and, as is indicated in fig. 13, it is clearly made up of coarse crystalline fibres. The orientation of these fibres should be carefully studied, as it affords a proof that the stereoplasm is a secondary structure, and not a simple addition to the thickness of the septa. At the thin innermost ends of the septa the secondary fibro-crystals are disposed at right angles to the long axis of the septum (as seen in transverse, *i.e.*, horizontal section), and here we seem to have the characteristic structure of the Madreporarian septum with a middle dark line or "centre of calcification," &c. But where the stereoplasm is thick and completely fills the interseptal loculus, it displays a number of curved lines of growth, generally emphasized by the deposition of curved bands of dark brown pigment, and it should be noted that, whereas the curved growth-lines of the septa have their convexities directed outwards, the reverse is the case with the growth-lines of the stereoplasm. The fibro-crystals of the latter, as is shown in fig. 13, are arranged in diverging bundles, conformably to the curved lines of growth, in such a manner as to appear to diverge from a stereoplasmic "centre of calcification" which is more apparent in tangential than in horizontal sections. It is obvious that, after the septa and synapticula have been formed, the soft tissues in the deeper parts of the corallum shrink away from the septal and synapticular surfaces both externally and internally, and as they shrink away the calicoblastic layer again enters into activity and deposits the coarsely fibro-crystalline stereoplasm that eventually fills up the interseptal loculi to a greater or less extent.

Concerning the brown pigment, I have very little to say. It appears to be deposited in the form of minute granules between the fibro-crystals, but I found it impossible to make sections sufficiently thin to admit of an accurate study of it.

I have entered at some length into this question of secondary deposit or "stereoplasm," as there appears to be unquestionable evidence of its existence in *Heteroeyathus*, and the minute structure of the corallum of this genus may prove serviceable in the interpretation of the structure of some fossil corals. Miss Ogilvie (**41**, pp. 93–99) denies the existence of a "stereoplasm" in both recent and fossil corals, and she was perfectly right as regards the corals that she describes. There is, however, a close analogy between the secondary thickening or stereoplasm described by von Koch (**29**) in *Pholidophyllum* and that of *Heterocyathus*, and it is possible that the structure of *Lonsdaleia indica*, as described and figured by Waagen (**51**), may be referred to the same type, but in neither case are the authors' figures sufficiently detailed to enable one to speak with certainty. The description given by Frech (**19**) of *Idastræa profunda*, and quoted at length by Miss Ogilvie (**41**, p. 99), might be applied with very little correction to *Heteroeyathus*, but in this case again the author's figure is on too small a scale to enable one to judge whether the structure is identical or not with that here described.

General Anatomy of the Polyp.—As described by Gardiner (**23**), the corallum is completely invested by the tissues of the polyp, the latter being interrupted only at the mouth of the *Aspidosiphon* chamber. It must be borne in mind that the young *Heteroeyathus* is attached to and grows round a gastropod shell (usually a *Cerithium*) tenanted by an *Aspidosiphon*, and that the growth of the coral and the Sipunculid proceed *pari passu* till we get the intimate association between the two forms characteristic of their adult condition. The shell, which served for the original habitation of the Sipunculid and the surface of attachment for the coral, is completely overgrown and eventually greatly exceeded in size by the latter. It is evident, then, that as the coral grows, its soft tissues must be folded down all round the edge of the cup to form a "perisarc," using that term in the restricted sense given to it by Bernard (**4**, p. 21). As the corallum grew round the shell, the perisarc must have kept pace with it; indeed, it would be more correct to say that the soft tissues enveloped the shell, and that their innermost ectodermic or calicoblastic layer secreted the corallum which eventually enclosed the shell, and, growing beyond its limits, formed the *Aspidosiphon* chamber. Eventually the edges of the perisarc, growing round the shell on all sides, meet and unite below, excepting in the region of the mouth of the shell. Thus we get a basal union of the perisarc similar to that observed in *Fungia*, and as in the last-named genus we find that the mesenteries are prolonged into the cavity of the perisarc and divide up the extra-thecal cœlenteron into as many entocœlic and exocœlic chambers as there are mesenteries. The mesenteries, however, do not extend to the centre of the base of the coral. They may be traced as far as the costæ, but die out where the costæ pass into the central irregular basal granulations, and here the soft tissues appear to be supported on the granulations in the manner described by Fowler (**16**). Above the level of the synapticula, which not only physiologically replace but are in some respects

morphologically equivalent to a true theca, the external portions of the exocœles and endocœles are continued into the corresponding internal chambers, and when the polyp is fully expanded the depth of these intermesenterial chambers must be considerable, owing to the relatively great height of the exsert septa. Spirit specimens are, of course, very much contracted, and the soft tissues are everywhere stretched over and down in between the septa, pali and columella to an extent that makes the interpretation of sections a matter of considerable difficulty.

The Tentacles.—These, as stated by GARDINER, are twenty-four in number, one corresponding to each endocœle. Owing to contraction it is somewhat difficult to determine the position of the tentacles in an expanded polyp, but it appears that the twelve tertiary tentacles form an external circlet situated quite at the edge or even outside the margin of the calyx. The six primary and six secondary tentacles form an inner circle within the margin of the calyx; they alternate with one another and the primaries are nearer to, but still at some considerable distance from, the mouth. The tentacles are thickly covered with knob-like batteries of nematocysts, which are conspicuous in sections. Each tentacle is attached at its base to the two members of a mesenterial pair, and the longitudinal muscle fibres of the mesenteries are continued up into and may be traced to the tip of the tentacle. In contraction the tentacles are completely introverted by the action of the muscle fibres, and in spirit specimens, owing to the excessive contraction of the mesenteries themselves, the invaginated tentacles are doubled over the endocœlic septa and each appears in sections to be prolonged downwards into two pockets, one in each mesentery of the pair to which it belongs (fig. III.).

The Peristome and Mouth.—Owing to the distance of the tentacles from the mouth, the peristome is of considerable extent. It is closely contracted against the numerous pali and paliform lobes at the inner edges of the septa, and its contours are scarcely distinguishable in spirit specimens. The mouth is an oval aperture whose size varies very much in spirit specimens; in some it is contracted to a narrow oval, in others it is widely open, giving a clear view of the soft tissues investing the columella. The mouth, according to all received ideas on Actinian anatomy, should open into a stomodæum, but in *Heterocyathus* there is no definite stomodæum, in the sense of a longer or shorter tube lined by a modified epithelium. The ectoderm of the peristome is very thin, and at the lips of the mouth it is somewhat thickened, and, as described below, there is evidence of a distinct sphincter oris and a distinct dilator oris (radiating fibres) muscle in this region. Immediately within the lips, but not uniting to form a complete tube, are the large gutter-shaped "filaments" of the six primary mesenterial pairs which undoubtedly perform the functions of a stomodæum, and may be described as twelve discontinuous portions of the stomodæum, united only by the thickened but not modified ectoderm of the lips. There is no trace of a sulcus or sulculus (gonidial grooves). The reduction of the stomodæum seems to be clearly due to the great development of the pali and the

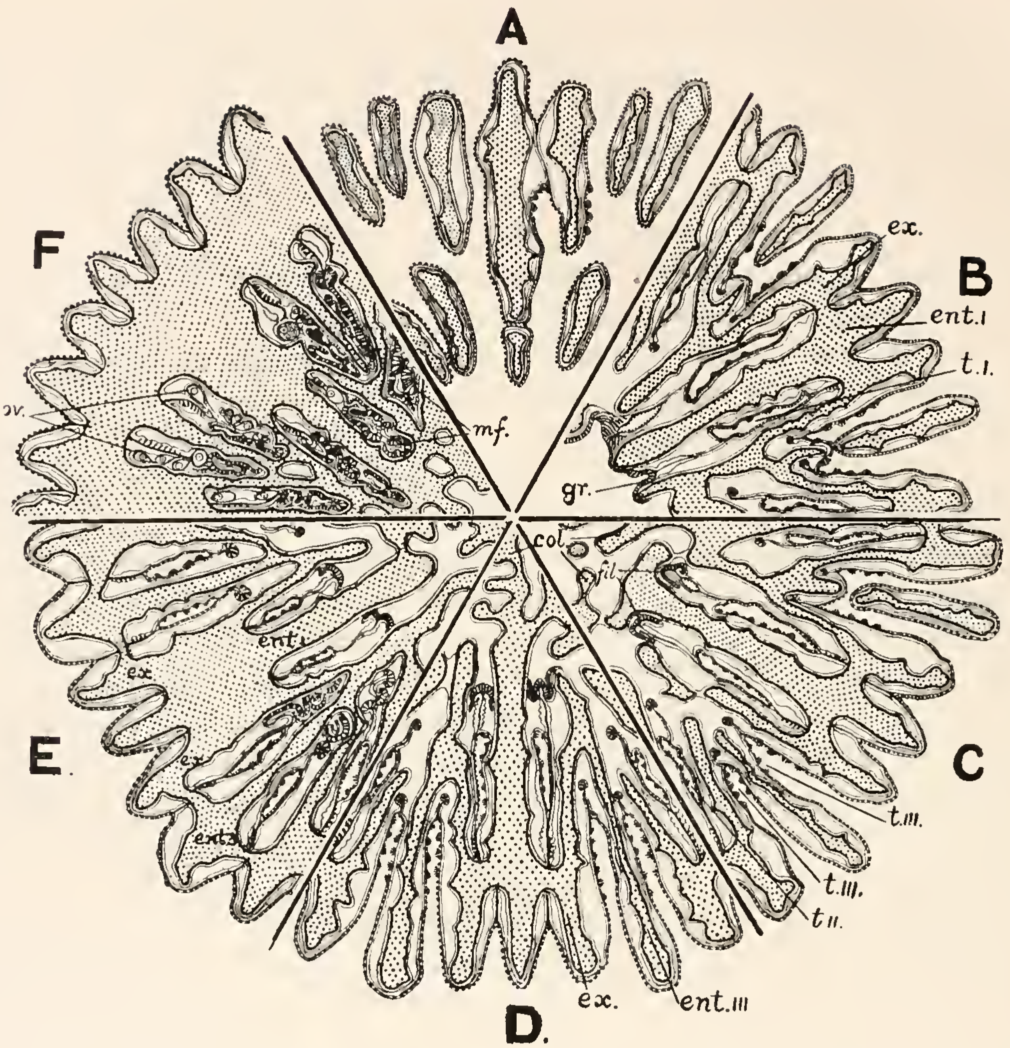

Fig. III. Semi-diagrammatic representation of six successive horizontal sections through the same sextant of *Heterocyathus æquicostatus.* The corallum is shaded with dots; the mesoglœa is represented by a black line, the endoderm by a contour line following the mesoglœa; the ectoderm is blocked. A passes through the exsert portion of the septa, B through the mouth, C and D are sections about 0·25 millim. apart and below the mouth; the interseptal loculi in these sections are not reduced by the formation of secondary calcareous deposit or "stereoplasm." In E a considerable amount of stereoplasm has been deposited in the loculi adjacent to the primary endoseptum. In F all the loculi are reduced by the deposit of stereoplasm and the mesenteries contain ova. *ent.*I., *ent.*II., endosepta of the first and third cycles; portions of the second-cycle endosepta may be seen at the edges of each sextant. *ex.*, exosepta. *fil.*, band-like primary mesenterial filaments. *gr.*, groove leading from the mouth to one of the primary mesenterial filaments. *m.f.*, coiled mesenterial filaments. *t.'*, *t.''*, *t.'''*, introverted tentacles of three cycles doubled over the corresponding endosepta. *col.*, columella.

columellar upgrowths. There is not, in fact, room for a stomodæum in the contracted polyp.

The Mesenteries.—These are of the normal Actinian character and are

forty-eight in number, consisting of six primary, six secondary, and twelve tertiary pairs. The muscle banners are well developed, and the directive pairs, as is usual, have the muscle banners on their outer faces. The general arrangement of the mesenteries and their relations to the septa, mouth, and peristome are shown in the diagram, fig. III., A, B, C, D, E, F, which represent six sections of the same sextant of a decalcified specimen of *Heterocyathus* taken at different levels. The six pairs of primary mesenteries extend further inwards than the rest, and they alone reach the mouth. The six secondary pairs are intermediate in length, and the twelve tertiary pairs are the shortest of all. As stated above, the free edges of the primary mesenteries at and below the lip of the mouth are broadened out to form a T-shaped or Y-shaped "filament" (fig. III., D, *fil.*). The inner face (*i.e.*, the face directed towards the central cavity of the polyp) is covered with a very thick ciliated epithelium which passes somewhat abruptly into the thinner but still thick epithelium of the lips. Below the level of the mouth the arms of the T- or Y-shaped filament become free from adjacent tissues and may be traced as broad ciliated bands, which in section appear T-shaped, or Y-shaped, or W-shaped, for a considerable distance below the level of the mouth into the gastro-vascular cavity. As long as they retain this size and shape, they are composed almost exclusively of very long attenuated ciliated epithelial cells, whose nuclei stain deeply and are closely crowded together; there are few glandular elements interspersed among the attenuated cells, and no nematocysts. Towards the bottom of the gastrovascular cavity these bands become smaller, and gradually assume the normal shape of a mesenterial filament; gland cells become more abundant and large nematocysts make their appearance. At the bottom of the cavity the filament is thrown into a complex coil, and is loaded both with gland cells and nematocysts of the large type. It is impossible to say, from a study of sections alone, whether the coiled masses at the bottom of the intermesenterial chambers are acontia, *i.e.*, free offsets of the edges of the mesentery, or simply coiled filaments. GARDINER (21) describes acontia in *Cœnopsammia*, but I am inclined to the opinion that in *Heterocyathus* the structures that might be mistaken for acontia are only coiled mesenterial filaments.

The filaments of the secondary and tertiary mesenteries do not reach the axial gastrovascular cavity, and are easily distinguished from the primary filaments. They are much smaller, especially in the upper part of their course, and have the usual kidney-shaped outline in section. Like the primary filaments they appear to consist almost exclusively of ciliated cells in the upper part of their course, but they soon show glandular cells and large nematocysts (Plate III., fig. 15). At the bottom of the gastrovascular cavity the filaments of the secondary and tertiary mesenteries are thickened and coiled like those of the primaries.

The absence of a definite stomodæum and the extent and importance of the ciliated bands forming the upper ends of the primary mesenterial filaments are features which, though peculiar, are readily explained by a consideration of their relations to the

palial and columellar structures. As may be seen in fig. III., C, the hammer-shaped palial process at the inner end of the primary septum cuts off the filaments of the primary mesenteries from the axial space, and in D the palus is seen to have contracted unions with the columellar pillars, cutting off the interseptal loculi from the axial space. It is evident that the broad ciliated filaments, extending far down in these nearly isolated loculi, are the chief if not the only agents in maintaining the circulation in the deeper parts of the loculi. Fig. III., F, shows how much the interseptal loculi become narrowed and isolated in the deeper parts of the coral in consequence of the abundant secondary thickening or stereoplasm.

All the mesenteries are fertile. In female polyps the ripe ova are large, and filled with granules of deutoplasm. I have been unable to make out details to my satisfaction, but the ova, when young, appear to become enclosed in the mesoglœa, and as they increase in size they project from the sides of the mesenteries, still enclosed in a thin mesoglœal envelope, outside of which is a layer of endoderm, forming a sort of follicle. The ripe ova are pyriform and hang in bunches from the sides of the mesenteries, each ovum attached by a slender stalk of mesoglœa and surrounded by its follicle of endoderm cells.

The relation of the mesenteries to the septa affords a strong presumption in favour of the view that these structures have been formed according to Pourtalès and Duerden's law. As has been shown, the septa are alternately exocœlic and endocœlic. The exocœlic septa, which on the usual system of notation would be called quaternaries, are larger than the endocœlic tertiaries, and, as is shown in fig. III., B and C, their inner ends meet and unite in front of the latter. Further than this, in each system the exocœlic septa adjacent to the primaries converge and meet together in front of the secondaries, forming the more or less distinct chevron-shaped pali described above. This union can best be seen in fig. II. As the tertiary endocœlic septa are enclosed within the smallest and therefore the most recently developed mesenterial pairs, and as they are themselves the smallest and least exsert of all the septa, and only unite with the Y-shaped figures formed by the exocœlic septa low down in the corallum (fig. III., B, C, and D), the evidence that they are the most recent in point of formation, and that they and the mesenterial pairs embracing them originated between the diverging Y-shaped outer ends of the exocœlic septa, in the manner described by Pourtalès and Duerden, is sufficiently convincing.

The little canals or tubes, running inwards from the lateral walls of the coral and opening into the *Aspidosiphon* chamber, have been described and figured by several authors, but their minute characters have not yet been investigated. They are almost exactly like the similar tubes in *Heteropsammia*, and the transverse section, Plate IV., fig. 24, of a tube of the latter genus serves equally well for *Heterocyathus*. The resemblance is the more striking because in *Heterocyathus*, an imperforate Turbinolid, there are endodermal canals, usually twelve in number, closely attached to the whole length of the tube, which is itself lined by an invagination of the

ectoderm. In *Heteropsammia* these canals form part of the system of endodermic canals characteristic of perforate corals, but their presence in *Heterocyathus* is remarkable. The transverse section has a curious resemblance to a section through a young Actinian with twelve mesenteries and a very wide stomodæum. The ectoderm lining the central tube is curiously modified at its inner end, as will be described below. The tubes vary in number and position. There may be from five to nine of them, and they are not, as a rule, in the same plane, but in the majority of specimens they are more numerous and more closely set together on the side furthest from the mouth of the *Aspidosiphon* chamber. Tangential sections of the corallum show that the tubes are interseptal, and that the stereoplasm filling up the interseptal loculi is interrupted by their presence. Being interseptal, their external openings are always between the costæ.

Histology.—Though Professor HERDMAN'S specimens are exceptionally well preserved, histological details are, as is usual in corals, difficult to determine to one's satisfaction. In what follows I do not profess to give a complete account of the histology of the different tissues, but will confine myself to such details as I have been able to make out to my own satisfaction.

The Ectoderm.—As is shown in fig. III., the ectoderm of the body-wall is more or less deeply infolded between the costæ in spirit specimens. It is thinner where it is stretched over the edges of the costæ and thicker in the furrows between, and this does not seem to be due to contraction in spirit and the consequent stretching of the tissue over the costal edges, but to a differentiation of the ectoderm, which is not only thicker, but more glandular and more richly provided with nematocysts in longitudinal stripes, corresponding to the attachments of the mesenteries. In the thinner stripes of ectoderm corresponding to the costæ the tissue consists almost entirely of columnar or cubical epithelial cells. There are very few gland cells, and few, if any, nematocysts. In the thicker stripes opposite the attachments of the mesenteries the epithelial cells are longer, and there are numerous gland cells and nematocysts of the kind shown in Plate III., fig. 18. The gland cells are of an elongated goblet form, with a compressed nucleus at the base of the goblet and a very thin protoplasmic stalk passing from the nucleus to the mesoglœa. They contain a number of yellowish-brown highly refractive granules, which do not stain with any of the ordinary aniline dyes, or with hæmatoxylin. Similar gland cells are very abundant in the ectoderm of the tentacles. The nematocysts, two of which are shown everted in fig. 16, are elongate oval in shape with a somewhat coarse thread coiled loosely within. The everted threads are covered with long barbs disposed in a spiral. Before eversion these nematocysts contain a flocculent substance which stains bright blue in picro-indigo-carmine, and therefore probably belongs to the class of hyalogens, all of which stain similarly with this dye.

The ectoderm lining the outer moieties of the tubes leading into the *Aspidosiphon* chamber is of the same character as that of the thickened stripes of the body-wall,

but it is remarkably modified in the inner moieties of these tubes. It becomes much thicker (Plate III., fig. 17) and has a vacuolated appearance, and in place of the gland cells described above we find elongated pyriform gland cells filled with round granules, which stain deeply in hæmatoxylin. But the most striking feature is afforded by the nematocysts. These are very numerous, closely crowded together, are ovoid in shape and very large, with a thick thread covered with barbs arranged in a double spiral. They contain coarse, closely-packed granules, which stain intensely blue in picro-indigo-carmine. In spite of their much larger size (figs. 16 and 17 are drawn to the same scale) and their different shape, I regard these as modifications of the ordinary nematocysts of the ectoderm of the body-wall. But they are certainly very strikingly modified, and I am at a loss to explain their function, situated as they are at the deeper end of tubes whose function is also problematical.

The ectoderm of the tentacles is raised into a great number of the well-known knob-like "batteries," crowded with small nematocysts of the usual form with a closely coiled spiral thread. Interspersed among these are larger nematocysts resembling those of the body-wall, but usually much longer and narrower. The ectoderm of the peristome is extremely thin, and consists of a cubical epithelium with very few gland cells, and, as far as I could ascertain, no nematocysts. At the lips of the mouth, however, the ectoderm is thickened, and shows some special features not visible in the ectoderm of the body-wall. There are very few gland cells, those which are present containing coarse granules staining blue in picro-indigo-carmine. I could not detect any nematocysts. Muscle fibres, which were scarcely distinguishable in the peristome, are here well developed and arranged radially so as to form a more or less distinct dilator oris muscle. In many sections the epithelio-muscular character of the ectoderm cells becomes evident. The layer of nerve fibres at and between the bases of the ectoderm cells is distinct, and among the epithelio-muscular cells very small attenuated, spindle-shaped cells may be distinguished which may be interpreted as sense cells. This thickened ectoderm passes insensibly into the endoderm at the lower margin of the lips, except at the places where the twelve primary mesenteries reach the mouth. Here it is continued into the very thick ectoderm of the Y- or T-shaped filaments of these mesenteries. In these filaments, as mentioned above, the ectoderm consists almost exclusively of very long attenuated, ciliated, epithelial cells, whose character is sufficiently indicated in fig. 14. There are very few glandular elements and no nematocysts. The coiled filaments of the bases of the primary mesenteries, and nearly the whole extent of the filaments of the secondary and tertiary mesenteries, consist of closely-packed, attenuated, epithelial cells, among which numerous gland cells and nematocysts are wedged in. The gland cells are of two kinds: (1) ovoid vesicular cells with clear contents; (2) pyriform cells containing coarse granules staining deeply in picro-indigo-carmine or hæmatoxylin. The nematocysts are all of the type shown in fig. 18. They are very large, measuring

0·06 millim. in length, and the central thread stains intensely blue in picro-indigo-carmine. They are clearly of the same type as, but somewhat larger than, the mesenterial nematocysts described by GARDINER (21) in *Cœnopsammia*.

As regards the layer of calicoblasts and the desmocytes, they are of the usual character, and I have nothing to add to what I have published concerning these structures in a previous paper (7).

The Endoderm.—As is usual in corals, the highly vacuolated endoderm cells are so badly preserved that nothing very definite can be said of their structure. They differ, however, in different regions of the body. The endoderm cells covering the muscle-banners and the extrathecal continuations of the mesenteries, and also those of the tentacular endoderm, are very long and columnar, and are crowded with Zooxanthellæ. As a rule there is a similar modification just within the mesenterial filaments, this modification being most pronounced in the primary mesenteries. Elsewhere the endoderm consists of a rather low columnar or cubical epithelium, and Zooxanthellæ are more scarce or, in some places, absent. GARDINER (21) lays great stress on the absence of glandular elements in the endoderm, but my observations do not support his conclusions. Glandular elements, it is true, are few or altogether absent, not only in the elongated endoderm above referred to, but in the whole or the greater part of the endodermic investment of the mesenteries. But in *Heterocyathus* the endoderm of the axial gastrovascular cavity, that is to say the tissue investing the pali and columellar upgrowths, is invested by a moderately thick cubical endoderm in which there are few Zooxanthellæ, but numerous ovoid or bean-shaped cells containing clear refractive granules which do not stain with any of the aniline dyes used, nor with hæmatoxylin. These cells are shown in Plate IV., fig. 19. It is, of course, possible that they may be modified nematocysts. Similar cells are found, though not so abundantly, in the endoderm wherever it is opposite a layer of calicoblast, and this would seem to suggest that the function of the cells in question is to elaborate material which is passed through the thin mesoglœal lamina to the layer of calicoblasts and converted into calcareous tissue by the agency of the latter. This view has a certain probability, because the calicoblasts form so thin a layer, and are themselves so retrograde in structure that it is difficult to believe that they are the only agents in the active growth of the corallum. On the other hand, I have observed fragments of copepods and diatoms in the intermesenterial chambers, at some distance from the filaments, and as these have evidently been or are being digested, it is equally possible that these glandular-looking cells in the endoderm may secrete a digestive fluid. At all events the facts do not warrant so sweeping an assertion as that of GARDINER, that the endoderm is excretory but not glandular, or the conclusions as to the homology of the Anthozoan layers that he has founded on it.

In some, but not in all my series of sections, the endoderm, in addition to the glandular elements described above, contained a number of large amœboid cells of

various shape, two of which are shown in fig. 20. They were very abundant in one series, but entirely absent in another, and in a third they were rare. They are filled with large refracting granules, which generally stain crimson in picro-indigo-carmine, but in some cases they stain a deep indigo blue. They can be nothing else than amœbocytes, and are probably excretory in function. Their abundance in one specimen and their rarity or absence in others is probably attributable to the different conditions of nutrition of the polyps in question. It is well known that the endoderm of Cœlenterates, *e.g.*, of *Hydra*, presents very different appearances according as the animal has been recently fed or starved, and I have found the most diverse appearances, particularly in the matter of the presence or absence of endoderm cells loaded with granules, in the endoderm of *Hydræ*, according as they had been fed abundantly or starved.

Finally, it may be noted that at the bottom of the axial cavity there are large spaces, and frequently there is a single large central space in the axial gastro-vascular cavity. The endoderm lining these spaces or space is invariably devoid of Zooxanthellæ and gland cells, and has the simple columnar form depicted in fig. 21.

As regards the occurrence of nematocysts in the endoderm, I occasionally found large nematocysts, of the second type characteristic of the tentacular batteries, in the tentacular endoderm, but invariably in close proximity to one of the batteries. I conclude, therefore, that these nematocysts were not formed in the endoderm, but have been forced through the mesoglœa into the endoderm during the violent contraction produced by the action of reagents. Elsewhere I could find no trace of nematocysts of any kind in the endoderm.

2. **Heteropsammia michelini**, M. Edw. and H.

(Plate IV., figs. 22 to 25.)

The remarkable analogies between this coral and *Heterocyathus æquicostatus* have been commented on by several authors. Both are built up round a gastropod shell tenanted by an *Aspidosiphon*, both have an exactly similar spiral *Aspidosiphon* chamber in the adult state. In both there is a minute Lamellibranch commensal with the *Aspidosiphon* within the chamber, and in both there is a number of minute tubes lined by ectoderm leading from the lateral walls of the coral into the chamber in question. The shape and general appearance of the two corals is closely similar, but whereas *Heterocyathus* is always a simple coral, *Heteropsammia michelini* generally exhibits two calices produced by fission of the parent calicle, and *H. multilobata* exhibits several calicles. The anatomy of the last-named species has been described by Fowler (18), who notes the following features. The external soft tissues rest on the echinulations of the cœnenchyme; the tentacles are simple, without nematocyst batteries, and are apparently both exocœlic and endocœlic; exosepta and endosepta are present, and certain of the septa fuse centrally, as in *Rhodopsammia*

(*Balanophyllia*); the number of mesenterial pairs is very variable and there are no directive mesenteries; the tubes leading into the *Aspidosiphon* chamber are lined by ingrowths of the body-wall consisting of ectoderm, mesoglœa, and endoderm. No account is given of the histology.

H. multilobata is a well-marked colonial form with several calices, whereas *H. michelini* usually has two calices only, and some of the differences between my observations and FOWLER's are no doubt attributable to the difference in habit of the two species. In older specimens of *H. michelini* the septal arrangement is sometimes very irregular, but in young specimens with a single undivided calicle the septa are arranged in a normal manner in six systems and four complete cycles, and their relations are practically identical with those described in *Balanophyllia*, and with a little trouble one may select a considerable proportion of adult specimens, in which two calicles have been formed by fissiparity, in which the septal arrangement differs very little from the normal.

The most interesting results, however, are obtained from specimens with a single elongated but as yet undivided calicle. I made a series of sections through one such specimen and another series through an obviously regular calicle of a specimen in which fissiparity was complete. The sections show that the septa are alternately exocœlic and endocœlic. In the first specimen with an undivided calicle there are two pairs of directive mesenteries defining the primary septa at each end of the long axis of the calicle. A portion of one side of the specimen was destroyed by the ravages of a boring sponge, but in the complete half I was able to count three systems and twenty-six endosepta arranged in four complete cycles, and a single septum of a fifth cycle in the chambers adjoining the directive septa. I have given a diagram of this specimen in fig. IV. The diagram is carefully constructed with reference to a camera drawing of the actual section, but the complexity of the actual drawing is so great, owing to the porous nature of the corallum, and the details are so minute that it is impossible to get them all into any figure of reasonable size other than a diagram.

It will be observed that the arrangement of the septa and their relations to the mesenteries are practically identical to what has been described in *Heterocyathus*. But particular attention should be paid to the exocœlic septa, which are shaded with lines to distinguish them from the endosepta. Nothing can be more clear than the fact that their peripheral ends have been thickened; that chambers have been formed in the thickened ends, whereby the septa became Y-shaped. And, finally, that the quaternary endosepta have been formed between the mesenterial pairs arising in the forks of the endosepta, and in some cases they have and in some they have not united with the inner ends of the exosepta. Moreover it is clear, from the manner in which the inner ends of the exosepta unite in the columella, that the tertiary endocœles must have been formed in exactly the same manner as the quaternaries obviously have been. There could not be a more striking demonstration of the validity of

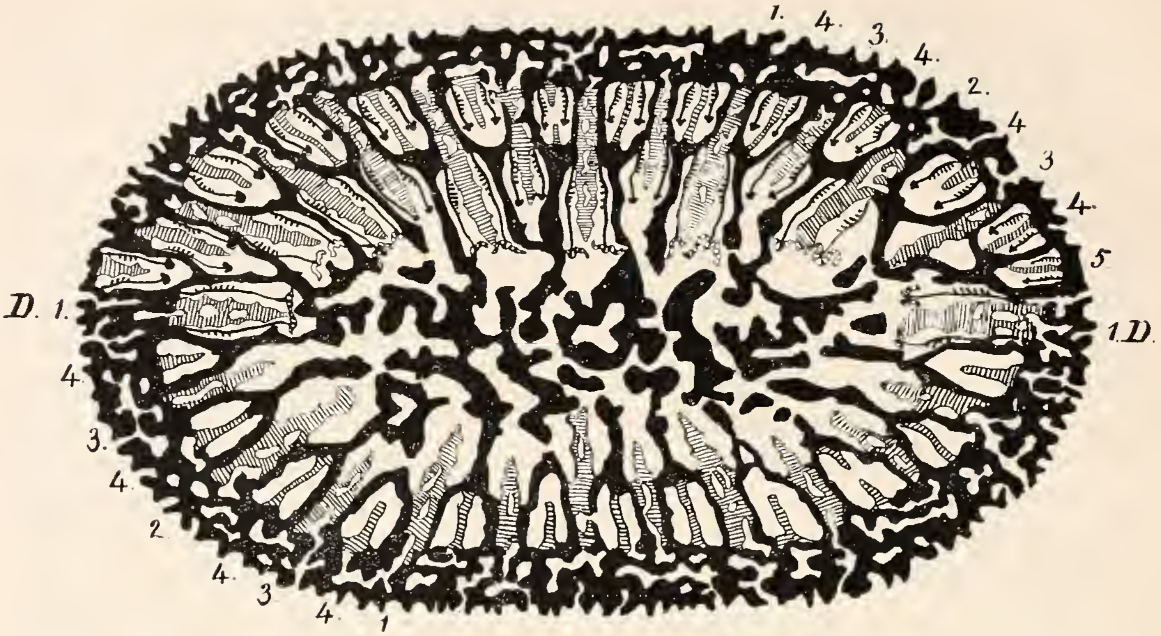

Fig. IV. Diagram of a specimen of *Heteropsammia michelini* in which the calice has not yet divided by transverse fission. The endosepta are cross-shaded, the exosepta, the porous theca, and the columella are black. The mesenteries are indicated in the upper half of the figure but not in the lower. *D*, *D*, directive mesenterial pairs. 1, 2, 3, endosepta of the first, second, and third cycles. 4, 4, fourth-cycle endosepta, each enclosed in a chamber formed by the forked peripheral ends of an exoseptum. In several cases the inner ends of the exosepta may be seen to unite in front of a tertiary endoseptum and to be prolonged beyond the point of union into the columella. 5, an endoseptum of the fifth cycle formed in a bifurcation of an exoseptum adjoining one of the directive endosepta.

Pourtalès and Duerden's law in the case of Eupsammid corals. It should be noted, however, that the quinary mesenterial pairs do not arise according to the sequence observed by Duerden in *Siderastræa*, but are contiguous to the sulcar (dorsal) and sulcular (ventral) primary septa.

My second series of sections, through a polyp which had been formed by transverse division from the original single parent polyp, gave some interesting results. A tracing of a section taken a little above the level of the stomodæum is given in fig. 22. The arrangement of the septa and mesenteries is remarkably regular. There are apparently six systems and three cycles of endosepta, with an additional quaternary septum in the chamber on the right side of the directive septum, that is to say, there is just half the number of endosepta that there was in the elongated and undivided specimen. The endosepta may be classified according to size and relations as primaries, secondaries, and tertiaries, but they cannot have made their appearance in this order, as they were derived from the pre-existing septa of the parent polyp. The number of parental mesenteries has evidently been halved in the process of division. No new septa have been added, but the quaternaries of the parent have become the tertiaries of the offspring.

Another singular fact is the presence of only one pair of directive mesenteries, the absence of the second pair being obviously explained by the division of the parent at right angles to the long axis of the calicle, whereby one pair of directives remained in the one, and the other pair in the other of the offspring. The existence of the single pair of directives in a coral which has doubled itself by a single act of fissiparity confirms the conclusion I arrived at in an earlier paper (5), that the absence of directives in many corals is to be explained by the fact that they have multiplied by fission.

To deal briefly with other points in the anatomy of the polyp. The external body wall, as FOWLER describes, rests upon the echinulations of the cœnenchyma, and there are no peripheral continuations of the mesenteries. The tentacles are all endocœlic, and therefore correspond in number to the endosepta. In contraction they are introverted, and in this condition are doubled over the inner edges of the endosepta. Thus they are situated nearer the mouth than in *Heterocyathus*, and the peristomial area is correspondingly reduced. The primary and secondary tentacles form a circle nearest to the mouth, the remaining orders form circles at greater distances from it, and it follows from their relations to the endosepta that the tentacles of different orders alternate with one another. In *H. michelini* the tentacles are covered with well-developed batteries of nematocysts; in *H. multilobata*, according to FOWLER, they are not.

There is a short, but distinct stomodæum, and I think that I found traces of a sulcus (gonidial groove), but of this I cannot be certain, as both my specimens suffered partly from the attacks of boring sponges, and partly from the fact that grains of quartz sand were lodged in the angles of the mouth and produced imperfections in my sections in those regions. However this may be, the circulation of water in the complex chambers in which the lower parts of the mesenteries are lodged is provided for by means similar to that described in *Heterocyathus*. The filaments of the primary and secondary mesenteries form broad sinuous bands in the upper part of their courses, and it is only deep down in the coral that one meets with the characteristic kidney-shaped sections of mesenterial filaments. The number and arrangement of the mesenteries has been sufficiently described. As far as I could determine, all the mesenteries are fertile, but in the undivided specimen of which I made sections the quaternary mesenteries, especially those in the lateral chambers, were in advance of the remaining orders as regards the maturity of ova contained in them. The ova, and as far as I could make out in a series of longitudinal sections the testes also, are embedded in the mesoglœa of the mesenteries in the manner figured by the HERTWIGS for *Actinia*, and do not hang from the sides of the mesenteries in follicles as in *Heterocyathus*.

H i s t o l o g y.—The external tissues were very well preserved, but the reagents had not penetrated well, and the endoderm and mesenterial filaments were in consequence macerated and of little use for histological examination.

The Ectoderm (fig. 23) of the body-wall is relatively much thicker than in *Heterocyathus*, and is richly supplied with gland cells and nematocysts. The character of the epithelial cells is well shown in the figure. The gland cells are of three kinds:—(1) Goblet cells with a central nucleus and filiform internal ends, the wider external end filled with small granules staining deeply in hæmatoxylin or picro-indigo-carmine. (2) Flask-shaped cells with broad internal ends and a narrow neck opening at the surface; these cells are filled with coarse granules which stain in the same way as those of the first variety. (3) A few large vacuolated sac-shaped cells whose contents stain with eosin, but remain colourless in picro-indigo-carmine.

The nematocysts are of two kinds. The small spiral-thread variety is fairly abundant, and here and there are large torpedo-shaped nematocysts with barbed threads, similar to those described for *Heterocyathus*.

The ectoderm lining the small canals leading into the *Aspidosiphon* chamber is not modified as in *Heterocyathus*, but contrariwise, it loses its glandular character and consists almost exclusively of ciliated columnar cells, among which nematocysts of the larger variety with barbed threads are to be found. In some of my sections the lumina of the tubes are packed with everted nematocysts of this kind, which have evidently been discharged when the polyp was killed, and this suggests that these canals serve in some manner as special batteries of nematocysts protecting the commensal Sipunculid. In fig. 25 I have given a representation of the manner in which these chamber canals pass through the general mass of cœnenchymal canals into the *Aspidosiphon* chamber. It will be observed that the endoderm canals, generally twelve or thirteen in number, surrounding them are specially related to the chamber canals and lie parallel to them.

The tentacular ectoderm is raised into large and broad nematocyst batteries containing numerous small spiral nematocysts and a lesser number of those of the larger type. In the peristomial region the ectoderm becomes thinner, less glandular, and contains but few nematocysts. At the lips it again becomes thick, and in this region the nervous layer is thicker than elsewhere, and I was able to observe a few large pale nuclei embedded in the layer of nerve fibrils which appear to belong to gland cells. In this region, as in *Heterocyathus*, the radially disposed muscular fibres of the ectoderm cells are very conspicuous, and one can equally well recognise the circular layer of endodermic fibres forming a sphincter oris.

The ectoderm of the lips passes without any abrupt change into the stomodæum. Here the same elements may be recognised, but in different proportions. The epithelial cells are elongated filiform, and their deeply staining elongated nuclei are closely crowded together. Nematocysts of the spiral and barbed types are fairly abundant, especially the latter variety. The glandular cells are much increased in number, especially the eosinophile cells of the third type. The layer of nerve fibrils at the bases of the cells is relatively thick. This structure is continued without much change into the broad filaments of the primary and secondary mesenteries, but in the

lower part of their courses the spiral nematocysts and the basophile gland cells become less numerous, and the number of eosinophile gland cells is correspondingly increased. The coiled mesenterial filaments were too much macerated to admit of accurate observation. I was only able to satisfy myself that they contain numerous large barbed nematocysts, but none of the spiral variety; that the epithelial cells are attenuated and closely packed together in groups, and that there are numerous very large eosinophile gland cells between the groups.

The endoderm was too much macerated to admit of careful study. The cells are evidently highly vacuolated, and their nuclei are unusually small. Zooxanthellæ are abundant in the most external cœnenchymal canals, but are scantily distributed in the deeper parts. In one of my specimens the endoderm was full of granular amœbocytes similar to those described in *Heterocyathus*.

3. **Dendrophyllia gracilis**, M. Edw. and Haime.

(Plate IV., figs. 26 to 28.)

The anatomy and histology of *D. ramea* has been fully described by von Heider (26), whose observations are so careful and accurate that I have little to add to them. He has given a very full account of the relations of the perisarc (edge-zone or "Randplatte"), and has fully realized the importance of the exosepta and the manner in which the tertiary mesenterial pairs, and the exosepta embraced by them, are formed in the Y-shaped peripheral extremities of these exosepta. The full significance of this observation of course escaped him, as he was unacquainted with Pourtalès' account of the development of *Balanophyllia*, and his memoir was many years anterior to Duerden's recent work.

Dendrophyllia is an arborescent genus propagating by lateral buds. The soft tissues extend for a considerable distance below the lip of the calicle, forming a well-marked edge-zone or perisarc. The septa and theca are thin and fragile, and there are well-marked external costæ corresponding to the septa. Correlated with the presence of costæ is the existence of peripheral continuations of the mesenteries in the perisarc, as has been correctly described and figured by von Heider. There is practically no difference between the septal arrangement of *D. gracilis* and *D. ramea*. In both there are three cycles of endosepta, and the exosepta alternate with the endosepta, forming an apparent quaternary cycle. Von Heider has given an excellent account of the manner in which the apparent quaternary exosepta meet and unite in front of the short tertiary endosepta, and his diagram (*loc. cit.*, plate xxxi., fig. 7) leaves nothing to be desired in clearness and accuracy. It is evident that the septa and mesenteries are formed in strict accordance with Pourtalès' and Duerden's law, and I am able to add this much in confirmation. I made a series of sections through a small lateral bud measuring about 2 millims. in diameter. In this bud there are only twelve pairs of mesenteries. Six pairs, of

which two are directives, are well developed and reach the stomodæum; they embrace the primary endosepta, the latter being tolerably well developed as narrow, ridge-like projections in the calicle, but with branched peripheral ends passing into the network of trabeculæ forming the cœnenchyme. Alternating with the endosepta are six exosepta of approximately the same size, whose peripheral ends bifurcate and enclose chambers in which are the mesenterial pairs of the second cycle. These secondary mesenteries are unequally developed, but not, as far as I could determine, according to any regular sequence. Each pair embraces an endoseptum, which in some cases is very rudimentary, but in other cases has grown centipetally and has united with the inner limb of the Y-shaped exoseptum (fig. V). Thus we see that in the bud the

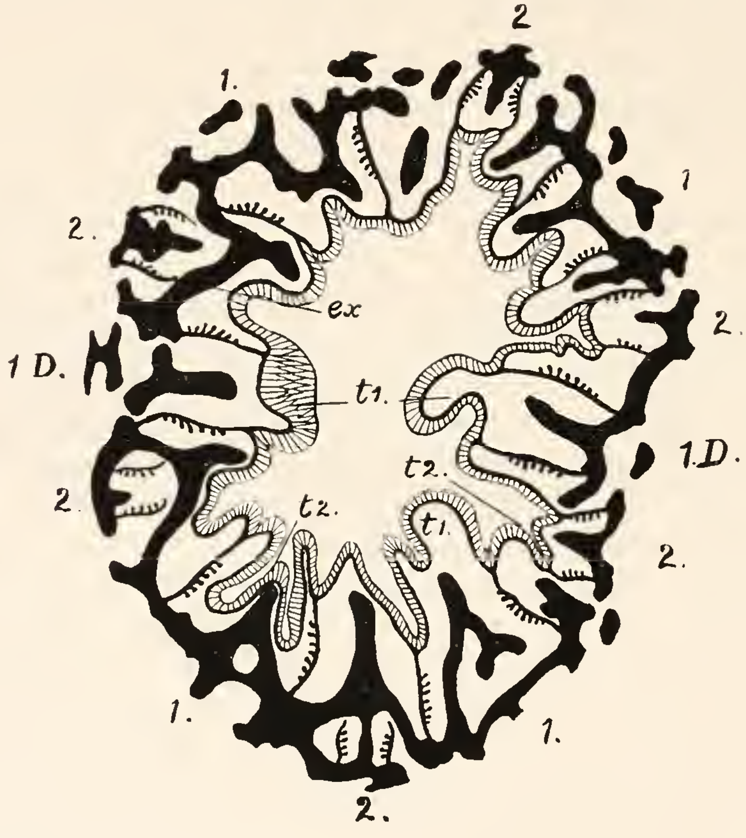

Fig. V. Semi-diagrammatic section through a young bud of *Dendrophyllia gracilis*. 1, 2, the primary and secondary cycles of endosepta embraced by the corresponding mesenterial pairs. *D*, *D*, the two pairs of directive mesenteries. *ex*, an exoseptum with forked peripheral ends, within which a pair of secondary mesenteries enclosing a secondary endoseptum is developed. t^1, t^2, tentacles of the first and second cycles corresponding to the endosepta.

secondary mesenteries, and the endosepta embraced by them, are formed between the bifurcated outer ends of the exosepta, and show the same relations to the latter that the tertiary endosepta show in the adult. This is a clear proof of the nature of the septal sequence.

Von Heider counted eighteen tentacles in one-half of a specimen of *D. ramea.* My specimens of *D. gracilis* were too much contracted to enable me to count with certainty, but I found, both in the bud and in the adult, indications of a cycle of exotentacles alternating with the primary and secondary endotentacles. The exotentacles appear to be simply introverted, and do not enter into close relations with the mesenteries. The endotentacles, as in *Heteropsammia,* are introverted and doubled over the inner edges of the endosepta. As far as I could determine, there are twelve exotentacles in the adult, alternating with the primary and secondary endotentacles. Thus there would be thirty-six tentacles of both kinds, and my observations agree with von Heider's.

The stomodæum is relatively longer than in *Heteropsammia,* measuring fully 1 millim. in length in the contracted spirit specimen, and in the expanded polyp it is probably much longer. I could find no trace of sulcus or sulculus. The stomodæal ectoderm extends some little way down the free edges of the primary and secondary mesenteries, as in *Heterocyathus* and *Heteropsammia,* but not so far as in these two genera, and eventually it gives place to a normal mesenterial filament.

As regards the histology, I have not very much to add to what has been published by von Heider. In *D. gracilis* the ectoderm of the body-wall is peculiar, and unlike anything that I have seen in any other coral. It is difficult to obtain a clear idea of its structure in sections, but it appears, as shown in fig. 26, that the cells are large and vacuolated, and form a thickened cell-wall, which, from its staining properties, seems to be of the nature of an intercellular substance. The walls of adjacent cells cohering together give a semi-cartilaginous consistency to the whole tissue, which no doubt forms an efficient protection against the numerous sponges and other organisms that infest the majority of corals. Embedded in the ectoderm cells are nematocysts of three kinds: (1) the common spiral-thread nematocyst measuring 0·02 millim. in length, more or less; these are very scantily distributed. (2) Medium-sized elongated nematocysts, about 0·028 millim. long and 0·005 millim. broad (fig. 27B) with a loosely and irregularly coiled thread; these are abundant. (3) Large elongate oval nematocysts about 0·035 millim. long and 0·01 millim. broad. According to Gardiner **(21)** the medium-sized nematocysts are developing stages of the spiral 0·02-millim. nematocysts, and this may be the case. It is not easy to speak with certainty on this point from a study of sections only, but there is some reason to think that the medium-sized nematocyst, as I have figured it, is really a third variety. In the first place they are very abundant in the ectoderm of the body-wall, whereas the small spiral nematocysts are very scantily represented there; in the second place they occur in the stomodæum in which no other nematocysts are to be found. Von Heider found two kinds of nematocysts in the ectoderm of *D. ramea,* the small spiral 0·02-millim. variety, and the large elongate oval variety, measuring in this case 0·05 millim. in length. He describes the latter as filled with a coarsely granular material, but without a thread, and a large

proportion of these nematocysts in *D. gracilis* present this appearance; but others may be found in which a thick thread loosely wound in a spiral of few turns is clearly distinguishable, and it is scarcely open to doubt that the forms filled with granular material are simply unripe. In fig. 27C I have drawn a nematocyst of this variety which seems to throw some light on the development of the thread. In the centre of the capsule is the pointed end of the thread (much longer than in *Cœnopsammia*) surrounded by a granular sheath which seems to be differentiating to form the eversible portion of the capsule. At the base of the capsule the granular sheath widens out and forms a rounded mass in which an irregularly and imperfectly formed coil can be distinguished: this I take to be the middle portion of the thread in course of formation. Near the point of the thread, and outside the granular sheath surrounding it, is a spiral of five turns closely wound round the granular sheath: this must be the terminal portion of the thread differentiated from the granular sheath at the same time that the latter gave rise to the eversible portion of the capsule. The capsule itself is lined by a rather thick granular layer. It should be observed that in these nematocysts the terminal part of the thread is wound round the eversible sheath near the aperture for the extrusion of the latter. GARDINER (*loc. cit.*, plate xxxiv., fig. 14) figures it at the opposite end of the capsule, but in *Cœnopsammia* the eversible sheath is only one-third the length of the capsule. In *Dendrophyllia*, moreover (VON HEIDER agreeing with me in this), there is a distinct spearhead-shaped tip to the thread, as in *Euphyllia*, whereas GARDINER found no such armature in *Cœnopsammia*.

In the "batteries" of the tentacles there are, as usual, very numerous and closely crowded nematocysts of the small spiral variety, and among them a considerable number of the second variety described above, which, if GARDINER is right, are to be regarded as early stages of the spiral variety. I think, however, that they are really a different form of nematocyst. I was able to distinguish a fine fibril passing inwards from the bases of many of the small spiral nematocysts, and in some cases I could observe that this fibril passed into a fine layer of protoplasm surrounding an oval nucleus, and that from this a fine branching fibril passed into the layer of nerve fibres overlying the mesoglœa (fig. 27A). The ectoderm of the peristome is very thick as compared with *Heteropsammia* and *Heterocyathus*, and contains a large proportion of gland cells and the same nematocysts as the ectoderm of the body wall. The stomodæal ectoderm, as VON HEIDER remarked, is composed almost exclusively of elongated cells of the columnar type; they are almost certainly ciliated, but the cilia had been destroyed by the action of alcohol. There are few gland cells, those that are present being of the flask-shaped finely granular type, in the stomodæum and very few nematocysts. All the nematocysts that I was able to recognise belong to the second variety described above.

The mesenterial filaments are crowded with gland cells and nematocysts, the latter all of the same medium-sized variety as those of the stomodæum, and this fact leads

me to think that GARDINER was in error in describing this form as a stage in the development of the small spiral variety. The mesenterial filaments are relatively small, and the absence of the largest ectodermal nematocysts is explained by the fact that there is no room for bodies of such size.

The endoderm is remarkable chiefly for the fact that Zooxanthellæ are very sparingly distributed in the mesenterial epithelium, and the epithelio-muscular cells are for the most part clearly defined and but little vacuolated. The muscular processes of the cells are remarkably well developed. Scattered through the endoderm, but somewhat sparingly, are minute nematocysts, about 0·01 millim. long, containing a loosely and irregularly coiled spiral thread. Each is contained in a transparent cuticle, and there is a flattened nucleus to one side of and *outside* the nematocyst itself. In the somewhat similar endodermic nematocysts of *Flabellum*, GARDINER (22) figures the nucleus inside the capsule of the nematocyst. The mesoglœa of *D. gracilis* is relatively thick, no doubt in correlation with the unusually great development of the musculature, but I could find no trace of structure in it. The desmocytes, described by VON HEIDER as calicoblasts, are well developed and form tassel-like groups at the points of attachment of the mesenteries to the theca, but otherwise present the usual features.

It is evident that the three forms whose anatomy is described in this memoir do not differ in any important points of anatomical or histological structure from the normal Actinian type, which has been shown by many authors to be characteristic of the polyps of Madreporarian corals. There are, indeed, minor characters, both anatomical and histological, which have a certain interest, but none of them can be regarded as having any classificatory value. One's attention is arrested by the presence of both endotentacles and exotentacles in some genera and of endotentacles only in others. But when we see that in the Eupsamniidæ, a well-defined family, only endotentacles exist in *Heteropsammia* while *Dendrophyllia* possesses both endo- and exotentacles, this character does not appear to be of much value. Moreover, owing to the great difficulty experienced in counting and localising the tentacles in spirit specimens, the information we possess on this point is not altogether trustworthy, and before any attempt is made to use the tentacles as an aid in determining the affinities of different genera of corals, it will be necessary to accumulate a large number of facts based on the study of living or well-preserved expanded polyps.

But a much more promising field is offered to the future investigator by the study of the relations of the septa to the mesenteries, especially by the developmental sequence of the endosepta and their connections with the exosepta, if present. My chief object in this paper has been to show that it is possible, by a study of the relations of hard and soft parts in the adult corals, to determine whether the septal sequence follows the rule established for *Balanophyllia* by POURTALÈS and *Siderastræa* by DUERDEN, and I have given sufficient evidence to show that the peculiar septal

arrangement of the Eupsammiidæ, which has been commented upon by many authors, is due to the sequence in question. I have further shown that the septal arrangement in *Heterocyathus*, an imperforate coral, can only be interpreted upon the same principle, and DUERDEN'S account of the development of *Siderastræa* is of itself sufficient evidence that a similar mode of septal sequence prevails both in perforate and imperforate corals.

On the other hand, it is clear from VON KOCH'S (32) and DE LACAZE DUTHIER'S (33) account of the development of *Caryophyllia*, that POURTALÈS and DUERDEN'S rule is by no means applicable to all corals, but that, contrariwise, there is another and distinct mode of septal sequence which is either independent of the formation of exosepta, or in which the part played by the exosepta is very different.

It is tempting to suppose that there are two principal modes of septal development among corals, typified by the Eupsammiidæ, *Heterocyathus* and *Siderastræa* on the one hand, and *Caryophyllia* on the other hand, and that the presence or absence of exosepta will indicate the group to which any given coral belongs. But while I think that it is very possible that a solution of many classificatory difficulties may be found by extensive investigations on the lines laid down by DUERDEN, I must recognise that it would be premature to make any positive statements in the present state of our knowledge. There can, I think, be very little doubt that forms like *Mussa*, *Euphyllia*, and *Galaxea*, which have endosepta only, cannot have been developed on the same plan as *Siderastræa*, but must have followed the mode described by VON KOCH for *Caryophyllia*. But this statement cannot be extended to all forms known to possess endosepta only. GARDINER (22) has shown that in *Flabellum* the new cycles of septa are at first exocœlic, and that in the course of growth a pair of mesenteries is formed in connection with each exoseptum, in consequence of which the exosepta become endosepta. I have shown (6) that the same rule holds good for the anthoblasts of *Fungia*. Though our evidence is not complete upon this point, I believe that this will be found to be the usual mode of septal formation in all corals which have only endosepta in the adult condition. It must be borne in mind that a coral in the course of growth increases not only in height but in diameter. As a consequence of its constantly expanding perimeter, the peripheral ends of the original radial structures (the primary and secondary septa) become further and further removed from one another, and the polyp forms new radial folds between which new radial calcareous structures are formed to fill up the gaps between the diverging septal extremities. These new radial structures are the exosepta or their equivalents. In those cases in which the exoseptal formations acquire a very intimate union at the time of their appearance with the adjacent endosepta, further peripheral growth is accompanied by a bifurcation or splitting of the peripheral ends of the exosepta, and a newer set of radial folds with corresponding calcareous structures is formed within their bifurcated extremities, as in the Eupsammiidæ, *Siderastræa*, &c. In other cases further peripheral growth is provided for by the formation of new radial folds *on*

either side of instead of between the forked peripheral ends of the exosepta, and these latter, as a consequence of the formation of new mesenterial pairs embracing them, become in their turn endosepta. But, whichever the mode of peripheral growth, it is obvious that the so-called "theca," about which so much discussion has taken place, is really the result of the formation of radial structures in connection with peripheral growth, and is not a circumferential structure. An examination of the figure in the text, fig. IV., will make this clear. Here the different stages of peripheral growth are clearly marked by the different distances from the centre of the insertions of the primary, secondary, tertiary, and quaternary mesenteries. The wall or theca must at each stage have been formed by the trabecular offsets of the peripheral ends of the exosepta united to the endosepta, and it is clear that the perforate "theca" of the adult is nothing more than a network of trabeculæ formed by the peripheral ends of the exosepta and endosepta. In *Heterocyathus* the wall is formed by the intervention of the synapticula, which must be regarded as being formed simply by very short radial folds between the outer ends of the septa, and are therefore quasi-septal structures, as has been pointed out for *Fungia* by Miss OGILVIE. In many corals the wall is formed by simple apposition of the thickened peripheral ends of the septa, giving rise to the so-called "pseudotheca." In others it is formed by the so-called "euthecal" pieces, which are really nothing more than very short radial structures intervening between the peripheral ends of the septa, but not produced internally so as to form septa. In the present state of our knowledge it would be unprofitable to pursue the subject further, but I may repeat that the whole tendency of recent investigation has been to show that a true theca, that is to say, a circumferential structure independent of the radial growths, or septa, is always to be referred to the prototheca, as defined by BERNARD, and that all other so-called "thecal" structures are in reality radial growths, formed in radial folds of the polypal walls, between previously existing radial structures. Further, it would seem from the most recent embryological investigations, which are confirmed by a study of adult structure, that there are two ways in which the new radial growth may take place: (1) by the simple formation of new radial folds between every pre-existing radial fold (*Caryophyllia*, &c.); (2) by the bifurcation of every alternate radial fold and the formation of a new radial fold in every space formed by such bifurcation (*Siderastræa*, *Balanophyllia*, *Heterocyathus*, &c.).

It is possible, but it would be rash to make a positive assertion at present, that these two modes of peripheral growth will be found to be of primary value to the systematist.

It may be worth while, in conclusion, to observe that the following corals have been found to have endosepta only:—*Mussa*, *Euphyllia*, *Madrepora durvillei*, *Madracis asperula*, *Duncania*, *Galaxea*, the lateral polyps of *Madrepora variabilis*. The following have been found to possess both exosepta and endosepta:—*Astroides*, *Stephanotrochus*, *Balanophyllia*, *Heteropsammia*, *Dendrophyllia*, *Heterocyathus*,

Madrepora aspera, the apical polyps of *Madrepora variabilis*, *Lophohelia*, *Seriatopora*, *Amphihelia*, *Stephanophyllia*, *Stephanaria*, *Sphenotrochus*, *Caryophyllia*, *Trochocyathus*, *Bathyactis*.

In *Flabellum* and *Fungia* there are both endosepta and exosepta, but the latter eventually become endosepta on the formation of mesenterial pairs embracing them. The list is incomplete, but it suffices to show that little reliance can be placed on the mere presence or absence of exosepta. On the other hand, I believe that it is of importance to discover in every coral whether the new endosepta are formed in the forked peripheral extremities of the exosepta, or simply by the formation of a new pair of mesenteries in connection with a radial upgrowth.

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EXPLANATION OF PLATES I., II., III., AND IV.

Fig. 1. *Rhodocyathus ceylonensis*, n. sp. Lateral view of the corallum. × 2.

,, 1A. ,, Diagram illustrating the arrangement of the septa. 1, 1, primary septa. 2, secondary septa. 3, 4, 5, tertiary, quaternary and quinary septa.

,, 2. *Cyathotrochus herdmani*, n. sp. A view of the corallum showing the paliform lobes, *p*, and one of the carinated directive costæ, *c*.

,, 2A. *Cyathotrochus herdmani*, n. sp. Calice from above. The numerals indicate the cycles of septa.

,, 3. *Flabellum crassum*, M. EDW. and H. Profile view of the corallum. *b.s.*, basal scar. (× 2.)

,, 3A. ,, ,, The calice viewed from above. The numerals indicate the different cycles of septa.

,, 4. *Flabellum rubrum*, QUOY and GAIMARD, var. *profundum*, M. EDW. and HAIME. The calice viewed from above, showing the different cycles of septa 1 to 5, and the parietal columella formed by spiny outgrowths from the lower ends of the septa.

,, 5. *Placotrochus lævis*, M. EDWARDS and HAIME. The calice viewed from above, showing the regular arrangement of the septa and the essential lamellar columella.

,, 6. *Balanophyllia parallela*, SEMPER. Profile view of the corallum. × 2.

,, 6A. ,, The calice viewed from above.

,, 7. *Balanophyllia cumingi*, M. EDWARDS and HAIME. View of a colonial aggregate of corallites. Nat. size.

,, 7A. *Balanophyllia cumingi*. Diagram of the septal arrangement. The numerals indicate the cycles of septa.

,, 8. *Balanophyllia socialis*, SEMPER. Profile view of the corallum.

,, 8A. ,, Diagram of the septal arrangement.

,, 9. *Balanophyllia taprobanæ*, n. sp. Profile view of the corallum, showing the enlarged primary costæ and one of the lateral buds, *b*.

,, 9A. *Balanophyllia taprobanæ*, n. sp. Calice viewed from above. 1, 1, the enlarged primary entocœlic septa. $X.^2$, the secondary exocœlic septum of the left-hand lateral system. $X.^3$, $X.^3$, tertiary exocœlic septa of the same system. $En.^2$, secondary entocœlic septum; and $En.^3$, tertiary entocœlic septum of the same system.

,, 10. *Lobopsammia robusta*, n. sp. Lateral view of the colony.

,, 10A. ,, ,, Diagram of the septal arrangement. The numerals indicate the cycles of septa.

,, 11. *Dendrophyllia minuscula*, n. sp. Profile view of the colony. × 2.

,, 11A. ,, ,, A calice viewed from above. 1, 1, primary entocœlic septa. $En.^2$, secondary entocœlic septum. $X.^2$, $X.^2$, secondary exocœlic septa (largely magnified).

,, 12. Side view of a primary septum of *Heterocyathus æquicostatus*, showing the septal trabeculæ emerging on the surface as spiniform granulations. *A.c.*, *Aspidosiphon* chamber. *p.*, pali and paliform lobes. *str.*, stereoplasm represented by cross shading. *syn.*, synapticulum.

,, 13. Portion of a horizontal section through the corallum of *Heterocyathus æquicostatus*, showing the diverging trabeculæ of which the septa are composed and the pigmented stereoplasm largely filling up the interseptal loculi. *S.*, *S.*, septa. *str.*, stereoplasm external to, and $str.^1$, stereoplasm internal to *syn.*, the synapticula.

,, 14. Section through a band-shaped primary mesenterial filament of *Heterocyathus*, some little way below the lip of the mouth. *c.e.*, ciliated epithelio-muscular cells of the filament. *en.*, endoderm. *mg.*, mesoglœa. ZEISS. Obj. D, Oc. 4.

,, 15. Section through a convoluted mesenterial filament of *Heterocyathus*. *en.*, endoderm. $gl^1.$, $gl^2.$, two varieties of gland cells. *n.*, nematocyst. ZEISS. Obj. D, Oc. 4.

Fig. 16. Section through the ectoderm of the body-wall of *Heterocyathus*. *gl.*, gland cells. *mg.*, mesoglœa. *n.*, *n.*, nematocysts. *nv.*, nervous layer. ZEISS. Imm. $\frac{1}{12}$. Comp. Oc. 4.

„ 17. Section through the inner end of one of the canals leading into the *Aspidosiphon* chamber in *Heterocyathus*. *gl.*, gland cells. *n.*, *n.*, ovoid nematocysts with granular contents. ZEISS. Imm. $\frac{1}{12}$. Comp. Oc. 4.

„ 18. A nematocyst 0·06 millim. in length from the convoluted mesenterial filaments of *Heterocyathus*.

„ 19. Endoderm covering the septa of *Heterocyathus* showing *gl.*, glandular looking cells, which may be degenerate nematocysts. An isolated cell is shown to the right of the figure. *zo.*, zooxanthellæ. ZEISS. Imm. $\frac{1}{12}$. Comp. Oc. 4.

„ 20. Endoderm of *Heterocyathus* showing *am.*, amœboid cells full of granules. *cal.*, calicoblasts. ZEISS. Imm. $\frac{1}{12}$. Comp. Oc. 4.

„ 21. Columnar endoderm from the axial gastro-vascular cavity of *Heterocyathus*.

„ 22. Semi-diagrammatic representation of a horizontal section through *Heteropsammia michelini* a little above the stomodæum. The corallum is black. The mesenteries, peristomial, tentacular and external ectoderm are represented by red lines. 1, 2, 3, the several cycles of endosepta. 4, a single endoseptum of the 4th cycle. *D.*, the single pair of directive mesenteries. $t.^1$, $t.^2$, $t.^3$, the several orders of tentacles, introverted and doubled over the endosepta.

„ 23. Ectoderm of the body-wall of *Heteropsammia michelini*. *en.*, endoderm. *gl.*1, goblet-shaped gland cells with granular contents. *gl.*2, flask-shaped gland cell. *mg.*, mesoglœa. $n.^1$, spiral nematocysts. $n.^2$, large nematocyst. *zo.*, zooxanthellæ. ZEISS. Imm. $\frac{1}{12}$. Comp. Oc. 4.

„ 24. Transverse section through a canal leading into the *Aspidosiphon* chamber in *Heteropsammia*. The histological details are indicated diagrammatically. *ec.*, ectoderm lining the canal. *en.c.*, endoderm canals surrounding the central ectodermic canal. *mg.*, mesoglœa. ZEISS D. Oc. 2.

„ 25. Modified ectoderm of the body-wall of *Dendrophyllia gracilis*, showing the thickened walls of the ectodermic epithelium. *mg.*, mesoglœa. n^2, medium sized nematocysts, 0·028 millim. in length n^3, large nematocysts, 0·035 millim. in length. ZEISS. Imm. $\frac{1}{12}$. Comp. Oc. 4.

„ 26. Nematocysts of *D. gracilis*. ZEISS. Imm. $\frac{1}{12}$. Comp. Oc. 4.

„ 26A. A spiral 0·02-millim. tentacular nematocyst, its inner end prolonged into a fine nerve fibril.

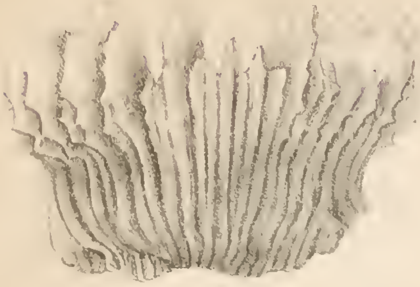
„ 26B. Nematocyst from the stomodæum or mesenterial filament.

„ 26C. Developing nematocyst from the external ectoderm (see text).

„ 26D. A ripe nematocyst from the external ectoderm.

„ 26E. The same diagrammatically represented.

„ 27. Four endoderm cells from a mesentery of *D. gracilis*, showing *n*, an endodermic nematocyst. *m.p.*, muscular processes. ZEISS. Imm. $\frac{1}{12}$. Comp. Oc. 4.



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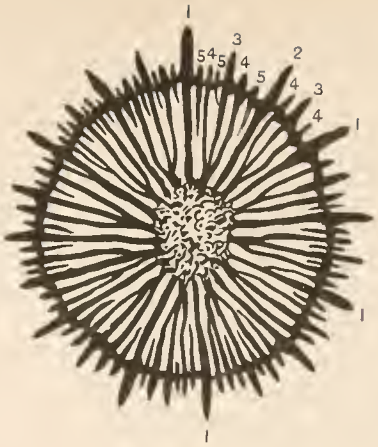

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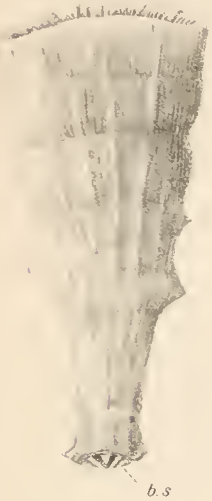

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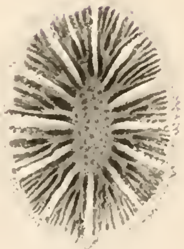

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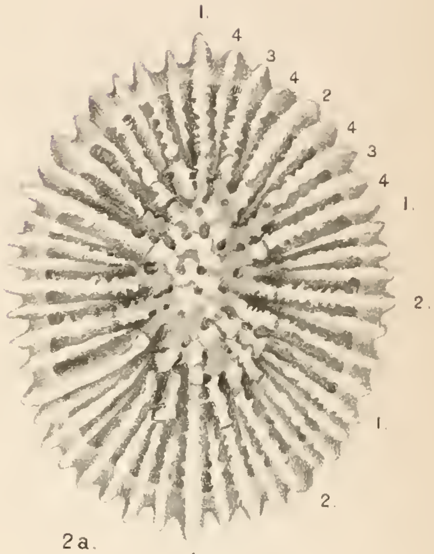

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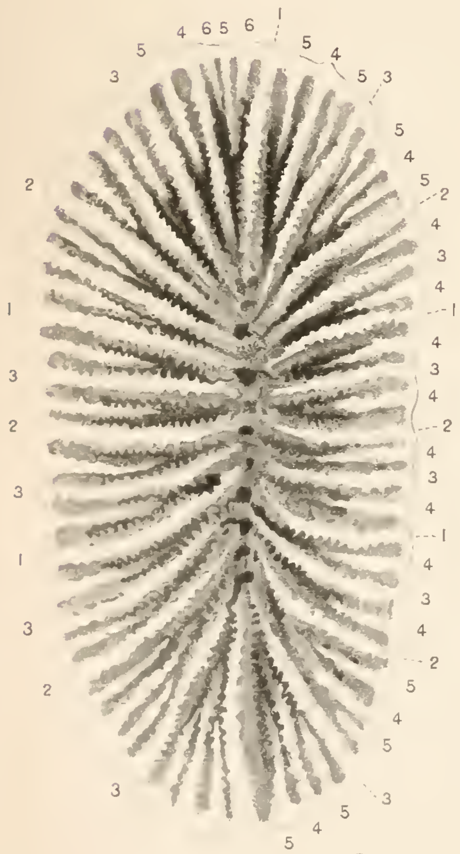

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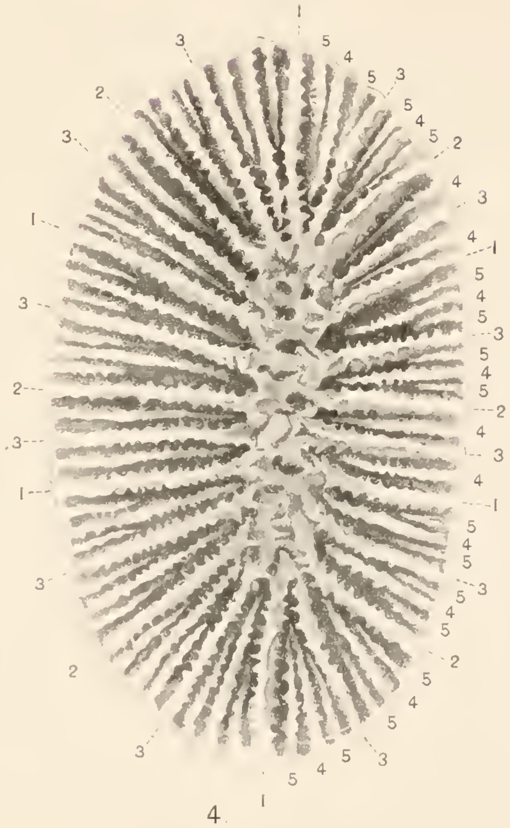

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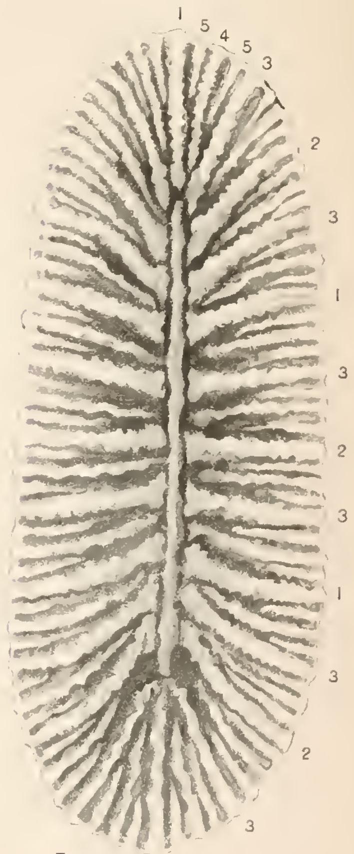

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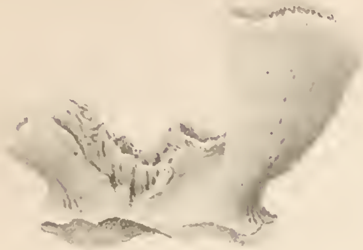

FIG. 7.

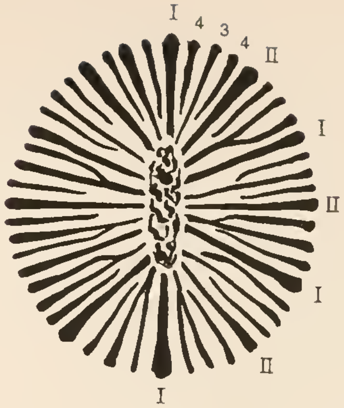

FIG. 8a.

FIG. 8.

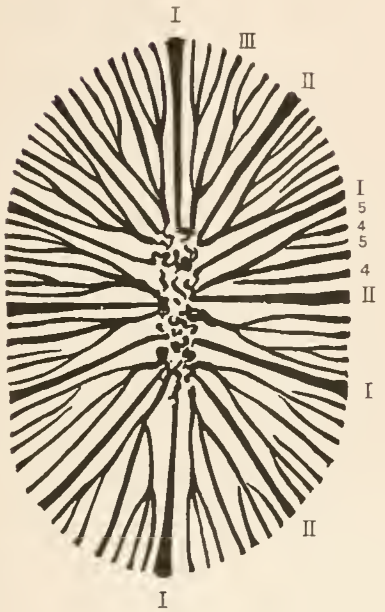

FIG. 7a.

FIG. 9a.

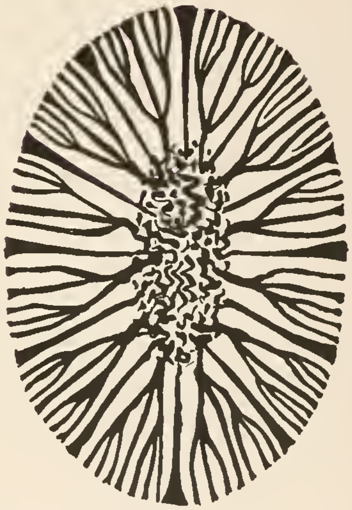

FIG. 10a.

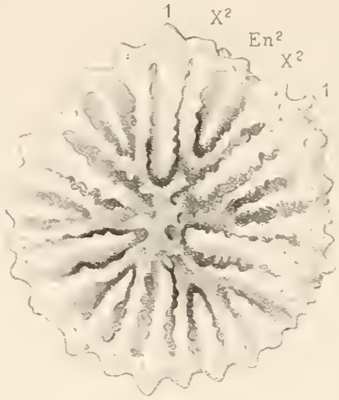

FIG. 11a.

FIG. 10.

FIG. 9.

FIG. 11.

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FIG. 12.

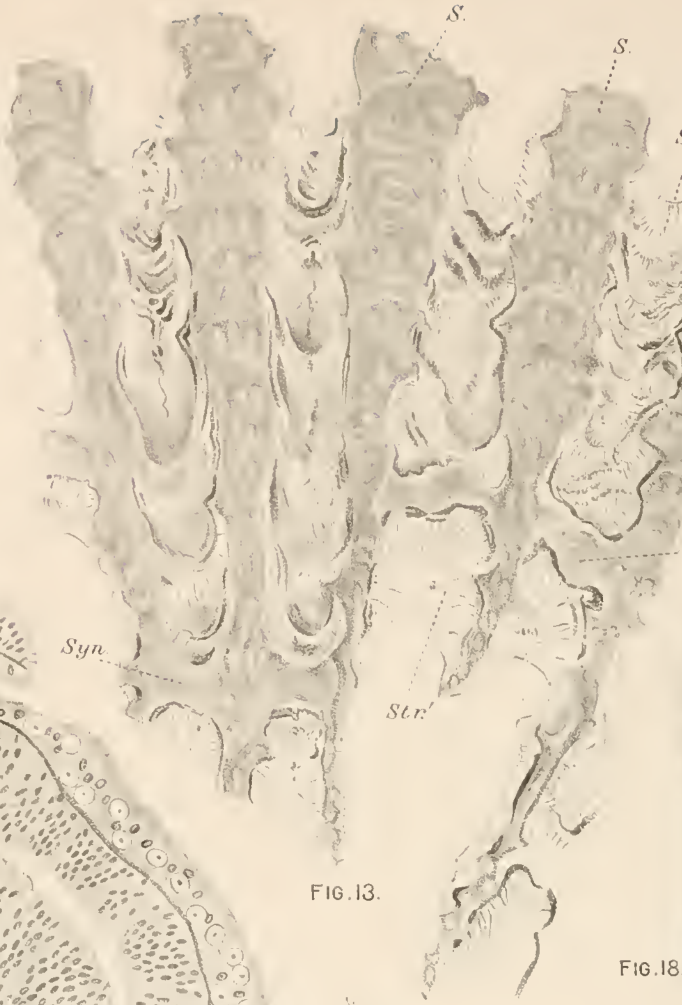

FIG. 13.

FIG. 18.

FIG. 14.

FIG. 16.

FIG. 15.

FIG. 17.

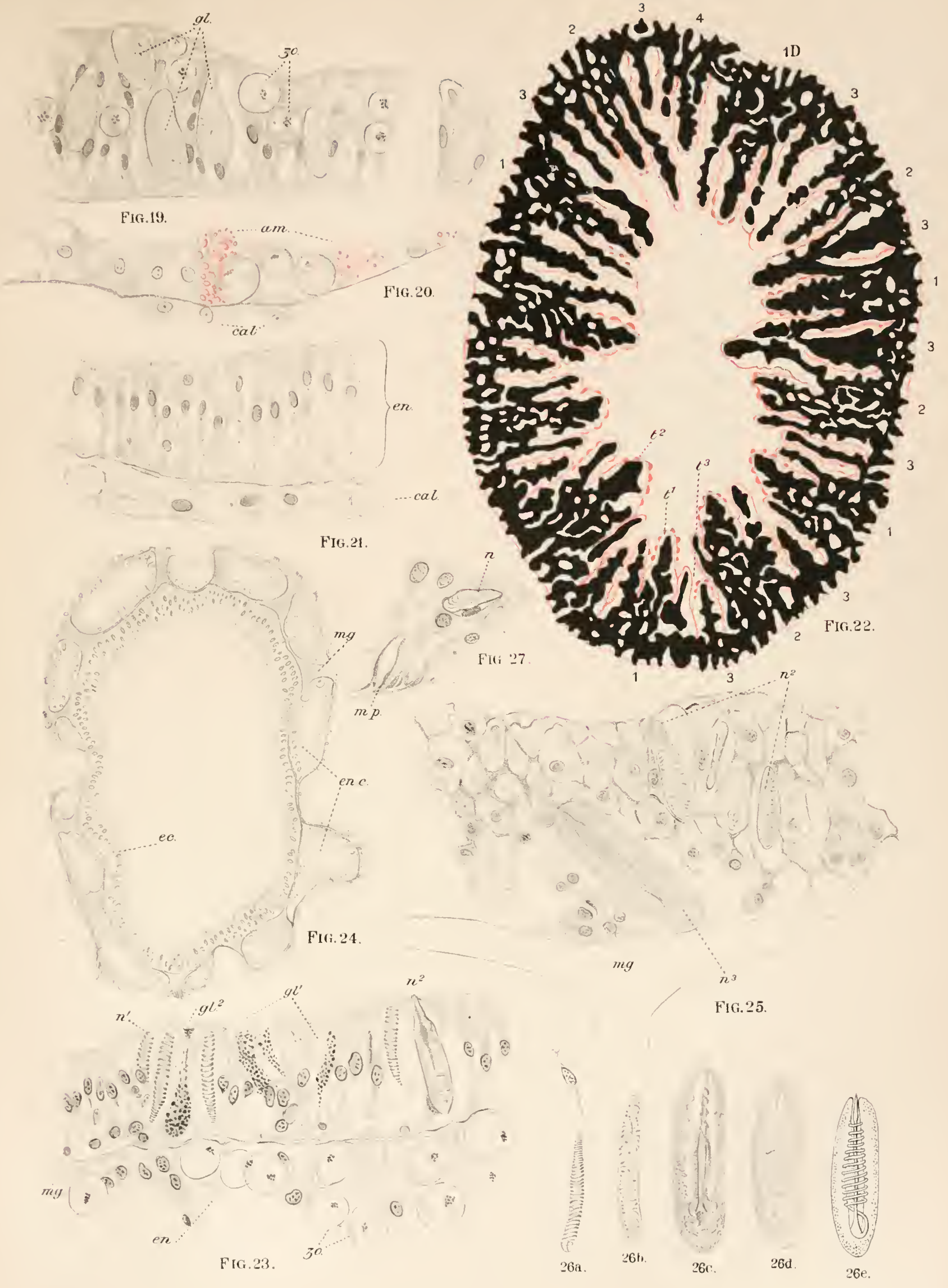

Fig. 19. Fig. 20. Fig. 21. Fig. 22. Fig. 23. Fig. 24. Fig. 25. Fig. 27.

E. Wilson, Cambridge

REPORT

ON THE

POLYCHÆTA

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

ARTHUR WILLEY, F.R.S.,

DIRECTOR OF THE COLOMBO MUSEUM.*

[WITH EIGHT PLATES.]

THIS collection of Polychæta is the most extensive which has been brought together from the coast of Ceylon. There are only three older collections of any magnitude from Ceylon upon which reports have been published, namely, that of SCHMARDA, worked out by the traveller himself and published in 1861 ('Neue Wirbellose Thiere'); a small series gathered by Mr. HOLDSWORTH and described by GRUBE in 1874 ('P. Zool. Soc., London'); lastly, another small series collected by Dr. HANS DRIESCH and described by MICHAELSEN in 1892 ('J. B. Hamb. Anst.,' ix. 2). Of these older collections the most important was the Schmarda collection, which included the discovery of the remarkable genera *Gastrolepidia* and *Bhawania*, the latter not being represented in Professor HERDMAN'S collection.

The material was handed over to me at Professor HERDMAN'S suggestion by Mr. JAMES HORNELL in September, 1904. A further consignment which had been

* EDITORIAL NOTE.—In order to save delay, I have, with Dr. WILLEY'S consent, undertaken to see this Report through the press without sending proofs to Ceylon. I have to thank Mr. ARNOLD WATSON and Mr. CYRIL CROSSLAND, both of whom are familiar with the group, for their kindness in reading the proofs along with me. The only change of any importance we have had to make is the name of the new genus on p. 251. Dr. WILLEY had proposed *Hololepidia*, but we regarded this as being practically the same as MOORE'S name *Hololepida* ('Proc. Acad. N.S. Philad.,' 1905) applied to an allied but distinct Polychæte, so we altered the title of WILLEY'S genus to *Hololepidella*.—W. A. HERDMAN.

taken to England, consisting mostly, but not entirely, of duplicates of some of the species contained in the first set, was sent out to me by Professor HERDMAN. These had also passed through the hands of Mr. ARNOLD T. WATSON, who kindly forwarded to me such notes and drawings as he had made, some of the latter being reproduced on Plate VIII. A species of *Polydora* which attacks the pearl oyster was subsequently forwarded by Mr. HORNELL.

Some new facts of systematic importance relating to previously described species are recorded here. Among the species described as new are some of considerable interest, *e.g.*, *Autolytus orientalis*, *Branchiomma quadrioculatum*, *Ceratonereis falcaria*, *Grymæa cespitosa*, *Halosydna zeylanica*, *Leprea inversa*, *Paramarphysa orientalis*, *Serpula watsoni*, *Thalenessa stylolepis*.

The occurrence of *Onuphis conchylega* and the recovery of *Harmothoe dictyophora* are also noteworthy features of the collection.

FAMILY: AMPHINOMIDÆ.

Chlœia flava (PALLAS)—Plate I., figs. 1 and 2.

Chlœia ceylonica, GRUBE, 1874, "Ann. Ceylon," 'P. Zool. Soc.,' p. 326.
Chlœia flava (SAV.), GRUBE, 'Ann. Semp.,' 1878, p. 10.

Four rather small specimens from Station LVI., Dutch Modragam Paar, 9 fathoms; average length about 28 millims., with 24 setigerous segments. Another smaller specimen is also in the collection.

Examples of dorsal and ventral bayonet setæ, the former barbed, are shown in Plate I., figs. 1 and 2. The branchiæ commence on the fourth segment; mediad of the violet tinted dorsal cirrus of the first four segments there is an accessory cirrus, that on the fourth segment being very slender. The caruncle of this well-known species is attached to the first two segments, and is produced backwards over the next two; it consists of an upper and lower series of lamellæ, those of each series united together in a zigzag manner by their lower ends; those of the upper series are further united together in couples along the crest of the caruncle.

The Amphinomidæ are not, I believe, as a rule, rapacious Annelids, but swallow sand and small stones, &c. Probably they are preyed upon by the Aphroditidæ, since the small specimen (No. 64) was penetrated by some of the enormously long barbed spines of *Hermione*.

A small worm taken in 24 fathoms, at Station LXIII., west of Periya Paar, seems to be a form of the same species; it is 9 millims. long, 20 segments. The tentaculum impar is nearly as long as the caruncle, and, like the dorsal cirri and the stems of the gills, deep purplish crimson in colour. No colour marks were observed along the back, and the crimson cirri stood out prominently from the midst of the very long and delicate setæ. Branchiæ commence as usual on the fourth segment; accessory dorsal cirrus observed on the first three segments only, as described by GRUBE; the folds of

the caruncle are more open, less closely set than in older worms. No barbed setæ were found. Unlike *Hesione ceylonica* (q. v.), young individuals of *Chlœia flava* do not possess the full number of segments characteristic of the adult.

Eurythoe complanata (Pallas).

Several examples of this species, whose distribution coincides with that of coral reefs, were obtained from Aripu Reef and at Galle, ranging in length up to 200 millims. and in breadth up to 17 millims. over the setæ. Branchiæ commence on the second setigerous segment and there is one dorsal cirrus to each parapodium. The caruncle is inserted into the first three setigerous segments.

Eurythoe latissima (Schmarda, *op. cit.*, p. 141) is a synonym of this species.

Eurythoe longicirra (Schmarda).

(See Schmarda, 'Neue Wirbellose Thiere,' ii., 1861, p. 142.)

Whether or not this is an exceptional form of *E. complanata* I am unable to decide, but it is certain that the caruncle is inserted upon the first four setigerous segments and overlaps the fifth.* The branchiæ commence on the second setigerous segment, and there is one dorsal cirrus to each parapodium.

Length 40 millims., width 5·5 millims. One specimen, from Aripu Reef.

Family: APHRODITIDÆ.

Hermione malleata, Grube—Plate I., figs. 3 and 4.

Hermione malleata, Grube, 'Ann. Semp.,' 1878, p. 17.
Hermione ridgewayi, Hornell, 'Ceylon Pearl Oyst. Rep.,' Part I., 1903, pp. 16 and 74.

Two specimens from old Dutch Modragam Paar, 9 fathoms, Station LVI.; one specimen from Aripu Reef, 18th March, 1902.

The malleiform processes described by Grube are clearly not definite morphological structures, but merely dermal folds associated with the elytrophores and branchial tubercles, the latter being transversely elongate.

This species is the Oriental form representing the Mediterranean species *Hermione hystrix*. I have satisfied myself on this point by actual comparison of the material from Ceylon with specimens of *H. hystrix* procured from the Stazione Zoologica at Naples for the special purpose of this investigation. The only serious divergence in Grube's description relates to the palps, which he describes as being smooth. His specimen only measured 16 millims. in length, and the palps, when examined under low magnification by transmitted light, appear smooth, though in reality they are beset with minute papillæ. The Neapolitan specimens of *H. hystrix* are larger and darker than the Ceylon worms; the elytra thicker and more opaque.

A complete Ceylon worm measures 30 millims. long by a width of 12 millims. over

* For further remarks on this point see Ehlers, 'Florida-Anneliden,' 1887, p. 30.

the neuropodia; fifteen pairs of elytra covering the back; length of dorsal glochideal spines up to 10 millims. (Plate I., fig. 3). Eye-peduncles rounded. Cirrophores and neuropodia thickly covered with minute rounded papillæ; neuropodia 3 millims. long. Ventral surface beset with similar papillæ. Tentaculum impar, tentacular cirri, dorsal cirri and first ventral cirrus with distal clavate tip articulated to the main shaft, which is expanded at this point. Palps 13 millims long, beset with six longitudinal rows of minute spiniform papillæ. The elytral segments carry on each side a flabellum of curved smooth-tipped setæ radiating dorsad and a backwardly directed fascicle of long brown glochideal setæ; below the dorsal setæ there is a tuft of fine silken threads. The neuropodia carry furcate setæ with or without an accessory tooth (Plate I., fig. 4). The portion of the notopodium from which the flabellum arises is adnate to the elytrophore.

Pontogenia indica, GRUBE—Plate I., fig. 5.

GRUBE, 'Ann. Semp.,' 1878, p. 18; HERDMAN, "*Palmyra aurifera*," 'Ceylon Pearl Oyster Report,' Part I., Narrative, 1903, p. 75.

The close resemblance between *Pontogenia indica* and *Palmyra aurifera* (see GRUBE, *op. cit.*, pp. 13–14) is one of the remarkable facts of Polychæt taxonomy.

The specimen was obtained from a living coral block in 6½ fathoms, one mile north of Muttuvaratu Paar, Station LIX. It measures 20 millims. in length and has 45 segments. The head is retracted within the anterior segments and beneath the anterior elytra, the second pair of elytra overlapping the ommatophores. The ceratophore is marked off from the frontal border of the prostomium and the ommatophores extend to this level. The palps are beset with longitudinal rows of delicate recurved papillæ. By pressing the ceratophore back a tuberculum faciale with granulated surface may be seen extending from the prostomium to the anterior border of the mouth. Each ommatophore carries two eyes, but as the pigmented areas overlap there appears to be only one eye in certain lights (Plate I., fig. 5). The paleæ which form flabella projecting over the elytra are utrinquedentate, as described by GRUBE. The dorsal setæ which occur in addition to the paleæ are long, delicate, colourless and numerous, and constitute a tela tomentosa over the elytra, concealing the latter, but not felted together so as to form an inextricable tangle. The two rows of distantly placed denticulations with their points directed towards the apices of the paleæ are not always visible in one view, and the paleæ then appear to be denticulate along one side only.

FAMILY: POLYNOIDÆ.

Iphione muricata, SAVIGNY—Plate I., fig. 6.

Polynoe peronea, SCHMARDA, 1861; 'Neue Wirbellose Thiere,' ii., p. 157.

Locality:—Gulf of Manaar. One specimen of the typical yellowish brown colour; length 17·5 millims., breadth over the setæ 8·5 millims. The head is withdrawn

between the anterior segments to such an extent that four pairs of elytra had to be removed in order to expose it (Plate I., fig. 6). The antennæ converge from the anterior pinnacles of the head towards the middle line, and then run side by side close together; one of them may sink down at a lower level, and then one only remains in view. They are subglabrous, being very sparsely and minutely papillose. SCHMARDA observed one antenna only, which he described as a tentaculum impar erroneously. There is no doubt as to the identification of the present specimen with SCHMARDA'S species; the only question is whether it is co-specific with SAVIGNY'S *I. muricata* (GRUBE, 'Ann. Semp.,' 1878, p. 21).

An elytron from the mid-body shows a concave anterior border, a large gold-coloured outer surface and a smaller pale inner portion directed obliquely forwards and overlapped by neighbouring scales. The whole surface of the elytron is divided up into polygonal, mostly hexagonal areas, and these again into numerous secondary areoles. The main areolation resembles that of *Harmothoe dictyophora*, but differs in some details; the areas are largest on the inner (mesial) portion of the scale, smaller along the outer and posterior borders; the secondary areolation is highly characteristic and was noted by SCHMARDA. Focussing through the superficial secondary areolation, another reticulum, which may be called the interstitial reticulum, comes into view, the meshes of which do not coincide with the former. The interstitial mesh-work shows nodal dilatations with a refringent body in each, like a nucleus, very clear in caustic potash. Proceeding to the pigmented portion of the scale, the surface enclosed by the secondary areoles becomes elevated to form low papillæ, which, near the outer border, assume the form of inclined spines. Posteriorly, certain of the primary areas become elevated to form long stout aculeate spines terminating distally in a pair of prominent horns and covered by numerous secondary spines, as figured by SCHMARDA. The secondary spines become larger distally, so that the main spine sometimes presents a more or less trifid appearance at the summit. The dorsal setæ are excessively numerous and bipinnate. The ventral setæ show a well-marked subterminal dilatation, a verticillate tract, and a smooth curved apical portion.

As for *Iphione muricata*, GRUBE makes no mention of the secondary areolation of the elytra, a highly remarkable feature; and he states that the outer and posterior margin of the scale is fimbriated, which is not so in *I. peronea*. Across the major diameter of the scale I counted about 30 primary meshes, and across one of the latter about nine sharply defined secondary areoles. There are 29 segments, 13 pairs of elytra. The anus is dorsal and is bordered by the last pair of elytra. SCHMARDA says the last segment has "zwei kleine Endfortsätze," but I cannot see them. The dorsal and ventral cirri, the palps and tentacular cirri are papillose. The tentacular cirri are concealed below the palps in dorsal view.

A smaller specimen, 5 millims. wide, shows a wide membranous fringe round the outer and posterior border, not yet areolated; there are no fimbriæ; about 17

primary meshes across the scale. The antennæ adhered together and broke away from their peduncles.

Lepidonotus carinulatus, Grube (1869)—Plate I., figs. 7 to 11.

(See Grube, 'Ann. Semp.,' 1887, p. 26.)

Localities:—South-west Cheval Paar, one specimen, broken in half, and several specimens mostly fragmentary; Chilaw Paar, Station LXIX., one specimen.

The antennæ and dorsal cirri show a very slight distal dilatation followed by a flagelliform terminal process. The cirri and palps are smooth; dorsal setæ more slender than ventral, 20 to 30 in number, disposed in three concentric arcs, the setæ of the dorsal arc being shorter than the rest. Ventral setæ about 25, bidentate and fringed (Plate I., fig. 11).

Elytral papillæ carinulate and spheroidal on the surface, echinulate and stellate near the fimbriated border; in some elytra the echinulate papillæ extend over the surface to the region of the scar. Elytra deciduous and body fragile; twelve pairs of elytra. Exserted pharynx with fringe of nine dorsal and nine ventral marginal papillæ. Some elytra become narrower towards the inner side than at the outer side, others are nearly equally wide throughout, with concave anterior border. Patches of dark brown pigment are scattered over the surface. The fimbriæ of the outer border are densely placed, those at the posterior border are sparser. Some scales are much less papillose than others; in a highly tuberculate scale the carinulate papillæ occupy the anterior and inner (mesial) portions; the echinulate papillæ occur at the posterior border, extending thence over the scar, this region being somewhat elevated; the echinulate papillæ near the outer border are smaller and less hirsute than those of the posterior border, sometimes presenting a more or less stellate appearance (Plate I., fig. 10). The prostomium (cephalic lobes) with eyes and antennary bases (ceratophores) is shown on Plate I., fig. 7.

Observations on a larger specimen, in which some of the elytra were better preserved in position, show that the dominant macroscopic character of the species lies in the difference between the elytra of the anterior region and those of the middle and posterior regions. The anterior scales (only those of the fourth and fifth segments are present in the specimen) are much smaller than the rest, they are placed subtransversely and their surface appears verrucose under low magnification. The more posterior scales show a finely granulose surface, they are about twice the size of the anterior scales (excluding the scales of the first pair, which are generally small and round, and are absent from this specimen), and they are longitudinally elongate, the anterior end narrower. All scales show a large opaque whitish patch in the region of the scar, and all are fimbriated externally. The length of the specimen is 17 millims.; total width over the setæ 5 millims. Along the posterior border of the elytra there are small saucer-shaped elevations which appear to be the bases of deciduous fimbriæ.

Microscopic examination shows that the verrucose appearance of the anterior scales is due to the presence of large numbers of spheroidal echinulate papillæ (Plate I., fig. 9). These papillæ do not occur on the posterior scales, which owe their granulose appearance to the ordinary carinulate papillæ (Plate I., fig. 8), small stellate papillæ and smooth globoidal papillæ.

The elytra of this species show an analogy with those of MARENZELLER's *Lepidonotus pleiolepis* from Japan, which, however, possesses fifteen pairs instead of the usual twelve pairs. Some individuals show a narrow black ring round the lower part of the subterminal dilatation of the dorsal cirri. In a specimen with extruded proboscis the outline of the prostomium was nearly circular.

This species appears to be the most abundant and typical representative of the genus *Lepidonotus* on the Ceylon pearl banks.

Lepidonotus cristatus, GRUBE.

GRUBE, 'Ann. Semp.,' 1878, p. 27; GRAVIER, 'Ann. Mer Rouge,' 1901, p. 212.

A fine example of this species, 43·5 millims. in length, 17 millims. wide over the setæ, was taken on the Galle Reef under a boulder, 7th June, 1902.

The smooth-bordered elytra show a large tumid bilobed transverse crest. The ventral setæ have the usual laciniate fringes on the region of the subterminal dilatation and end in a smooth curved tip. The distal portions of the antennæ, tentacular cirri, dorsal cirri and first ventral cirrus, up to the subterminal bulb, are coloured black.

GRAVIER describes for the first time the modified ventral setæ of the second segment, which are characterised by the possession of a very long verticillate tract.

Lepidonotus trissochætus, GRUBE.

GRUBE, 'Ann. Roth. Meer.' (Ehrenberg coll.), 1869; 'Ann. Semp.,' 1878, p. 25.

Locality:—South-east Cheval Paar. Length of the specimen 12 millims., breadth over the setæ 5 millims.

This species is distinguished by the possession of two kinds of setæ in the dorsal ramus of the parapodium, and these setæ are very numerous. There are rather short, stout, transversely spinulose setæ of a common type, and enclosed by these are numerous fine smooth capillary setæ ending in a point, a short distance below which there is a delicate dilatation, as in a spear-head without barbs; these may be called hastate setæ. In the anterior half of the body the hastate setæ do not project beyond the spinulose setæ which surround them, and cannot therefore be seen without adopting special measures. In the posterior half the hastate setæ project far beyond the short spinulose setæ, which occur like a sheath at the base of the bundle; they project here as far outwards as the ventral setæ. The resulting difference between the anterior and posterior dorsal fascicles as seen under low magnification is very pronounced. It

is, however, probably due to a temporary protrusion of the setæ, but it may serve to account for the alleged difference between *L. trissochætus*, Gr., and *L. indicus*, Kinberg. The hastate setæ can clearly be retracted and protruded at will. In one segment they are projecting on one side, retracted on the other. The elytra are sparsely covered with smooth obtuse pustules of varying sizes, the smaller and more numerous occupying a submarginal position. The margin of the elytron is quite smooth.

As indicated by Grube in 1869, this species presents a cryptocephalous condition, as in the later described species *L. cryptocephalus*, the head being concealed below a projecting collar formed by the second segment. The dorsal cirri are smooth, with a terminal flagellum and a subterminal swelling. The palps are beset with conical papillæ, and terminate in a smooth attenuate extremity (seen in one of the palps only). The ventral setæ have simple hamulate extremities (not bidentate) with the usual subterminal fringes.

Halosydna zeylanica, n. sp.—Plate I., figs. 12 and 13.

Total length about 15 millims., width 2 millims. to 2·5 millims. Commensal on Astropecten, Ceylon seas.

Body much flattened, extremely fragile, elytra smooth, colourless, covering the dorsum, leaving parapodia exposed, lightly attached to the elytrophores. The prostomium is divided by a shallow linear groove into two halves, upon which no eyes were observed, and the bases of antennæ and tentaculum are somewhat concealed below the frontal border of the head, though arising at one level, as seen in frontal view. The number of segments may be as many as 50, but this will depend upon age and variation, and the same applies to the number of the elytra, the highest number observed being 24 pairs.

The chief character is presented by the distribution of the elytra on the following segments :—II., IV., V., VII., IX., XI., XIII., XV., XVII., XIX., XXI., XXIII., XXVI., XXIX., XXXII., XXXIII., XXXV., XXXVII., XXXIX., XLI., XLIII., XLV., XLVII., XLIX. The peculiarity here is the occurrence of successive elytra on segments XXXII. and XXXIII., a point which I have verified on three specimens. In the specimen of which the elytral formula is given above, the elytra were lost from a number of the posterior segments but present on No. XLIX.

The dorsal ramus of the parapodium is very small, and the setæ which issue from it are few in number, plain and hyaline. Foreign particles adhere to all the setæ individually throughout their exposed portions. The ventral setæ have the form shown in Plate I., fig. 13, a plain apex slightly curved, and at some distance removed from it a dilatation with a projecting semilunar cusp. The number of ventral setæ varies, but is about 12.

The ventral cirri are shorter than the ventral ramus, arising from a prominent base. The dorsal cirri are plain structures occurring on the segmenta nuda, arising from a

projecting base which lies obliquely outwards and backwards when seen from above. The dorsal cirri are highly deciduous. They exceed the length of the parapodium (Plate I., fig. 12). The dorsal ramus and elytrophore of a foot from an elytra-bearing segment appear to carry long vibratile cilia. No tubercles were observed on the segmenta nuda. The ventral ramus is richly furnished with decussating muscles. The elytra are orbicular, glabrous, with few "veins" ramifying out from the scar.

Harmothoe dictyophora (Grube)—Plate I., figs. 14 to 16.

Polynoe dictyophorus, Grube, 'Ann. Semp.,' 1878, p. 44.

Locality :—East side of Cheval Paar. Length 12 millims., breadth over the setæ 4·75 millims.

Prostomium normal, anterior eyes placed in the centre of the lateral border (Plate I., fig. 15). Antennæ ciliate; palps beset with numerous minute blunt papillæ; dorsal cirri densely ciliate, the long filiform papillæ ceasing at the base of the terminal filament; no dilatation below the terminal filament. Dorsal setæ numerous, verticillate spinulose, but the whorls are not complete, only occupying three parts of the circumference of the setæ; the shorter setæ of the dorsal bundle are distinctly stouter than the ventral setæ; ventral setæ without exception conspicuously bidentate, dilated at a point variously remote from the apex and spinulose thereafter (Plate I., fig. 16). The spinulose tract of the superior ventral setæ is much longer than that of the inferior.

Thirty-five segments; fifteen pairs of elytra covering the back. Exposed portions of the elytra divided into polygonal areoles carrying chitinous spines and filiform papillæ; some of the areoles are densely pigmented dark brown. Some of the spines are bifurcated, such spines being particularly prominent on the round elytra of the first pair. The outer fimbriæ of the elytra are longest and densest, these are followed posteriorly by a group of papillæ with globular tips, and these again by shorter filiform papillæ (Plate I., fig. 14). It should be noted further that the ventral cirri also carry short blunt papillæ, scattered and not very numerous.

Grube founded the species upon a single elytron.

Hololepidella, n. gen.

A Polynoid; antennæ arising at a lower level than the tentaculum impar; segments and elytra numerous.

Hololepidella commensalis, n. sp.—Plate I., figs. 17 to 20.

Station I., off Negombo, 12 to 20 fathoms, on *Clypeaster humilis*.

This species appears to be allied to *Polynoe venosa*, Grube ('Ann. Semp.,' p. 43), in which however there were only 18 pairs of elytra and 42 segments in the single

individual examined. The number 18 is a generic character of *Acanthicolepis*, McInt. (= *Dasylepis*, Mgn.), but it seems likely, though not certain, that a polymeric Polynoid with more than 18 pairs of elytra will pass through a stage with 18 only. At any rate, *Polynoe venosa*, Gr., does not belong to the genus *Acanthicolepis*.

Those polymeric Polynoidæ in which the paired antennæ arise at a lower level than the tentaculum impar appear to be inadequately classified. Malmgren's genera *Nemidia* and *Enipo* are at most only sub-genera of Schmarda's *Hemilepidia*.

All Polynoidæ (*s. str.*) in which the antennæ arise at a lower level than the tentaculum are placed in the sub-family Harmothoina. The genus *Polynoe* (*s. str.*) is polymeric, having more than 45 segments in the fully formed condition. It comprises two sections:—(1.) *Hemilepidia*, Schmarda, in which there are 15 pairs of elytra restricted to the anterior region of the body. This section comprises the following species:—*Polynoe scolopendrina*, *Hemilepidia erythrotænia*, *Nemidia torelli*, and *Enipo kinbergi*. (2.) *Hololepidella*, *n.g.*, in which the elytra are not so restricted. Very possibly Grube's *Polynoe venosa* belongs here in spite of its few segments. The species now described also belongs to this section.

In *Hololepidella commensalis* the small antennæ clearly arise at a lower level than the tentaculum (Plate I., fig. 20). The elytra are pale, delicate, translucent, smooth, large, orbicular, covering the back; the first pair with central insertion, the others with excentric insertion near the anterior margin becoming submarginal in the posterior region; there is an indication of nervures radiating out from the scar of insertion, as in *P. venosa*. The elytra are inserted upon segments II., IV., V., VII., IX. * * * * * XXI., XXIII., XXVI., XXIX., XXXI., XXXIV., XXXVI., XXXVIII., XL., XLII., XLV.; segment XLIV. has an elytrophore on the left side, a branchial tubercle and cirrophore on the right side. There are 46 segments present, incomplete behind; in a fragment of the posterior end the alternation of cirrophores and elytrophores, the former sometimes skipping one segment, sometimes two, seems to be continued to the end of the body, but it is not always easy in this region to distinguish between a cirrophore and an elytrophore.

Head hexagonal; ground colour of body nearly black (becoming brown after a length of time in spirit) with a pale ridge across each segment between elytrophores and branchial tubercles respectively. Palps, antennæ, tentacle and cirri smooth; first ventral cirrus long, the rest short, with swollen basal portion and terminal flagellum. Dorsal cirri dark brown, tapering to a pale blunt point which may be slightly swollen, but without subterminal dilatation. The setæ are pale; dorsal setæ, about 8, broad parce-serrulate, much shorter than the ventral setæ; superior ventral setæ obliquely laciniate towards apex, giving the appearance of alternate serrulations, inferior ventral setæ with subterminal dilatation, curved simple tip and normal fringes (Plate I., figs. 17 to 19).

This species is one of those which easily undergo fragmentation, so that the length cannot be given; the width is 2 millims.

Gastrolepidia clavigera, SCHMARDA.

(SCHMARDA, 1861, 'Neue Wirbellose Thiere,' ii., p. 159.)
Gastrolepidia amblyphyllus, GRUBE, 'Ann. Semp.,' 1878, p. 46.
Gastrolepidia clavigera, HERDMAN, 'Ceylon Pearl Oyster Report,' Part I., 1903, pp. 29, 79.

Localities:—Station XVIII., off Rameswaram, 7 to 8 fathoms; Station LXI., off Periya Paar, 12 to 14 fathoms.

The lateral portions of the sterna of the segments are produced into conspicuous imbricating lamellæ, arching below the bases of the parapodia. They are semilunar folds, but if a segment is detached from the body and looked at from behind, they appear to be subcordate, as figured by SCHMARDA. The dorsal elytra are inserted upon segments II., IV., V., VII. * * * * * * * XXIII., XXVI., XXIX., XXXII., XXXV., XXXVI., XXXVIII., XXXIX., XLI., XLIII., XLV., this enumeration being based upon one specimen from which all the elytra had fallen off; the other specimens were smaller and showed fewer elytrophores, so that the peculiar distribution of the posterior elytra could not be confirmed. Dorsal setæ curved, stout, shorter than the ventral setæ, with as many as forty serrulations along the convex border; superior ventral setæ with not less than fifteen laciniate fringes; inferior ventral setæ stronger than the rest, with curved simple tips, subterminal dilatations and about eight fringes. The antennæ are inserted at a slightly lower level than the tentaculum. Dorsal cirri clavate, mostly lost. Beyond the club there is a terminal flagellum shown by GRUBE, omitted by SCHMARDA.

FAMILY: ACOËTIDÆ.

Panthalis, KINBERG.

This is a genus of Acoëtidæ characterised by the reversed imbrication of the anterior scales.

The family to which it belongs agrees with the Aphroditidæ (*s.str.*) in having pedunculate eyes; with the Sigalionidæ in the polymeric body; with Polynoidæ in having only setæ simplices; with Iphionidæ in having serrated jaws. It is clearly a family of composite affinities and its members possess an extraordinary interest, regarded from bionomical and anatomical points of view. They manufacture a felted tube woven from chitinous silken fibres which appear to be homologous with the fibres composing the dorsal felt of *Aphrodite*, that is to say, modified setæ which issue from the dorsal ramus of the parapodium and are contained within a convoluted sac intruding into the body cavity. The tube-forming habits of *Panthalis œrstedi* have been admirably described by Mr. ARNOLD T. WATSON in the 'Transactions of the Liverpool Biological Society,' vol. ix., 1895, pp. 169 to 188.

Two species of *Panthalis* were described by GRUBE from the Philippines, and very fortunately both of these are represented in Professor HERDMAN'S material from Ceylon, so that I am able to supplement GRUBE'S diagnoses with additional facts and figures.

Panthalis melanonotus, Grube—Plate I., figs. 21 to 27.

Grube, 'Ann. Semp.,' 1878, p. 48; also Part I., 'Ceylon Pearl Oyster Report,' p. 71.

Locality:—Station LIV., south of Rameswaram, 40 fathoms. One specimen.

A typical cirrus-bearing parapodium from the anterior region has the following structure:—(i.) A short dorsal cirrus consisting of a stout basal portion and an acuminate apical portion; (ii.) the dorsal ramus supported by a flexible acicula and penetrated by the tomentose setæ which are employed in weaving the tube; (iii.) the ventral ramus with four kinds of setæ, dorsally a small bundle of very fine serrulate setæ, then a bundle of long delicate penicillate setæ, then a central group of stout so-called aristate setæ; lastly, a ventral bundle of long spinulose setæ (Plate II., figs. 24 to 27). At the tip of the aristate setæ there is an alveolus. From the 28th segment the peduncle upon which the dorsal cirrus is inserted acquires a geniculate appendix, containing a prolongation of the internal tissues, possibly a diverticulum of the gut, but of this I cannot be certain without transverse sections. A few segments farther back an ovate or subcylindrical appendix appears on the squamiferous segments, in the same position as that occupied by the cirriform branchia of the Sigalionidæ, also containing the same kind of tissue as that which occurs in the geniculate process above described. The surface of these processes is not ciliated (Plate I., figs. 22 and 23).

Panthalis melanonotus appears to be an Indo-Pacific representative of the Mediterranean and Atlantic *P. œrstedi*. The accounts given of the eyes of the latter are rather puzzling. Von Marenzeller* denies the existence of eyes, although the ocular peduncles are present. Mr. Watson, in the article referred to above, has omitted to note the presence or absence of black pigment,† stating that the sight of the animal is good, each reddish-coloured eyestalk being faced with a clear lens, and having at its tip a rounded papillated appearance.

In *Panthalis melanonotus* the stalked eyes are very large and provided with abundant black pigment, in the centre of which is a lens; the eyes are subspherical, occupying the extremity of the clavate peduncles. In addition there is, as described by Grube, an eye-spot on each side of the prostomium behind the ocular peduncle; between and slightly behind the sessile eye-spots the median tentacle arises. The antennæ are small and largely concealed by the eye-stalks and were not seen by Grube (Plate I., fig. 21).

The extruded pharynx bears distally thirteen papillæ above and the same number below, forming a terminal crown; the median dorsal papilla is enlarged and the median ventral is lost from the specimen. The palps show pigment spots and appear glabrous with a simple lens, although minute papillæ can be found with the microscope, especially towards the apex, but there is no marked distinction between apical and

* V. Marenzeller, 'Polychæten des Grundes,' Vienna, 1893, p. 28.

† Mr. Watson informs me that no black pigment is visible in the eyes of the specimens of *P. œrstedi* now in his possession.—W. A. Herdman.

basal portions, such as occurs in the next species. The body is incomplete behind, upwards of fifty segments being preserved; total width of anterior region 6 millims. The specimen is well preserved.

Panthalis nigromaculata, Grube—Plate I., figs. 28 to 32.

(Grube, 'Ann. Semp.,' 1878, p. 50.)

Locality:—Station II., North of Negombo, 9 fathoms. One specimen.

Antennæ arising from the frontal margin of the prostomium; the tentaculum impar of about the same length, from the occipital margin. Only one pair of eyes observed on the slightly protuberant lateral borders. Palps short and stout, the anterior half densely fimbriate. Dorsal cirri short, ventral cirri subarticulate at tip. Each foot (after the first few pairs) is provided with a silk-producing gland which is apt to remain in the body after the extraction of the parapodium, the silken strands being drawn through the orifice of the notopodium.

The anterior elytra are inversely imbricate, inserted upon the elytrophores near the posterior border; the third elytra touch in the middle line behind the head (Plate I., figs. 28 to 31). The elytra were observed on segments II., IV., V., VII. and all subsequent odd segments up to XXXI., after which the body was quite flaccid and collapsed, full of the gold-coloured glistening silken coils and firmly attached to the tube at the posterior end.

The anterior portion of the tube was mostly free from the body of the worm, though slightly connected therewith by loose silken strands. The elytra are subtranslucent, colourless. The extruded proboscis carries a crown of marginal papillæ, eleven above, thirteen below; the median dorsal papilla is barely larger than the others. The setæ differ from those of *P. melanonotus* considerably. The dorsal group of setæ in the ventral ramus consists of small spinulose setæ, the spinules arranged in three remote whorls, below which the seta is slightly dilated; next a few fringed setæ; then the strong aristate setæ in two groups above and below the acicula; finally the ventral group of spinose setæ (Plate I., fig. 32). There are no penicillate setæ.

Length of anterior portion, including the proboscis, 13 millims.; width about 3 millims. Length of the posterior flaccid portion about 13 millims.

Family: SIGALIONIDÆ.

Psammolyce zeylanica, n. sp.—Plates I. and II., figs. 33 to 43.

Locality:—Ceylon Seas. One specimen, incomplete.

A fragment comprising about thirty setigerous segments, length 17 millims., body width 5 millims., 8 millims. over the setæ. The dorsum is completely encrusted with fine particles, chiefly calcareous débris, leaving the setæ exposed at the sides. The elytra are thin, transparent and triangular, the base of the triangle directed forwards. The basal area is clear, but the hinder area bears a luxurious growth of club-shaped

and capitate papillæ to which the foreign particles adhere. The anterior pair of elytra probably meet or overlap, but in general the elytra are confined to the sides of the body, leaving the mid-dorsum free. Nevertheless the latter is covered with sand grains which adhere to dermal capitate papillæ (Plate I., fig. 33).

The prostomium, carrying two pairs of eyes, is overshadowed by the massive ceratophore. There are no paired antennæ on the prostomium, these having become adnate to the cirrophores of the buccal segment which carry the tentacular cirri and bundles of plumose setæ (Plate I., fig. 34). The lower side of the ceratophore carries a pair of dermal folds or lobes, which project from the sides below and inwards. The ventral surface is not encrusted, but is thickly beset in each segment with transverse rows of not very long acuminate papillæ which are continued upon the ventral surface of the parapodia. The ventral middle line is depressed. Amongst the bases of the acuminate papillæ are scattered minute globular papillæ reminding of those present in *Hermione*. The cirrophores (appendages of buccal segment) lie between the palps and the head, so that it is difficult to remove a cirrophore without the palp of the same side; the palps are glabrous.

The simple plumose setæ of the buccal segment have been mentioned above. In the second segment in addition to the plumose setæ there are compound setæ of the form represented in Plate II., fig. 36, with filiform apex of the appendix, the shaft being plumose. The ventral cirrus of the second segment is stout and long, nearly twice as long as the parapodium, and arises from a distinct basal joint. In the third segment compound setæ of more usual form appear, the shafts being stout and smooth except towards the extremity where they are squamose (Plate II., fig. 37); the appendices are lost. The dorsal cirrus of this segment has the articulated structure shown in Plate II., fig. 35. In the fourth segment the shafts of the compound setæ are still squamose distally; the appendix is elongated, curved at apex with a slight truncation jutting out below the apex. In a parapodium of a normal body-segment (anterior third of body) there is a dense dorsal fascicle of finely plumose capillary setæ, followed by a superior ventral group of moderately stout compound falcigerous setæ with subelongate appendices; then a central group of stout compound setæ with shorter appendices; finally an inferior ventral group of slender setæ with elongate appendices (Plate II., figs. 38 and 39). Sometimes the apex of the appendix is clearly bidentate, varying from this condition to smooth (Plate II., fig. 40). The ventral border of the parapodium is beset with acuminate filiform papillæ and some spheroidal papillæ (Plate II., fig. 41). The elytra are notched and lobed, especially at the inner border (Plate II., fig. 42).

Psammolyce rigida, Grube—Plate II., figs. 44 to 47.

Grube, 1868, 'Ann. Roth. Meer.' (Frauenfeld); 'Verh. zool.-botan. Ges. Wien,' p. 631, 1878; 'Ann. Semp.' (Philippines), p. 55.

Locality:—Station LIII., 10 miles north of West Cheval Paar. Three specimens,

one complete, 115 millims. long, tapering gradually behind; 8 millims. wide over the setæ.

This species has the same general appearance as the *Psammolyce arenosa* of the Mediterranean. It is probably distinct in minor points, though I cannot specify what these points are without comparing actual specimens.

It differs from the preceding species in the following superficial respects:—

Ps. zeylanica.	*Ps. rigida.*
1. Colour fuscous.	Colour fulvous.
2. Calcareous grains predominate.	Quartz grains predominate.
3. Venter beset with capillary papillæ, *i.e.*, Venter hairy.	Venter beset with globular papillæ, *i.e.*, Venter tuberous.
4. Terminal portion of dorsal cirrus of third segment slenderer and shorter than its peduncle.	Terminal portion of same cirrus tapering and longer than its peduncle.

The parapodial armature of the two species shows such close correspondence that the slight differences which are observable could easily be attributed to individual variation, but the differences noted above under Nos. 3 and 4 would seem to preclude the possibility of regarding them as co-specific. Unfortunately I have no information as to the precise locality of the *Psammolyce zeylanica*. In Professor HERDMAN'S 'Narrative' of his expedition, *Psammolyce* is recorded from two stations, LII. and LIII. The latter is that from which the present species was dredged in 7½ to 9 fathoms, "bottom muddy sand with some dead shells;" the former station may be the locality of the other species, "between north of Cheval Paar and Vankali reef; depth 3 to 6 fathoms; bottom sand."

The difference noted above in respect of the adventitious coating of sand-grains is only of local significance as indicating a difference of habitat. The tuberculation of the ventral surface of the body is the most obvious character of this species. The low rounded dermal tubercles are placed close together without reference to segmental limits and not in rows, forming an even, elastic sole on each side of the depressed neural tract. The dermal tubercles are continued upon the parapodia, especially in the posterior two-thirds of the body, where they are thickly covered. Besides these spheroidal dermal tubercles there are tufts of filiform papillæ like those shown on Plate II., fig. 41. These occur on the base and summit of the parapodia, at the base of the ventral cirrus, and there is a ventro-lateral tuft on each segment between the tubercular tract and the parapodia.

Other substantial differences between the two species are shown in the figures. The elytra are formed upon the same model in both, and they are not safe objects for comparison, since they vary from segment to segment. Those of *Ps. rigida* have a concave anterior border, those of *Ps. zeylanica* are straight. The scar of insertion is short in the former, elongated in the latter (Plate II., fig. 46). The setæ of the second segment have a shorter appendix (Plate II., fig. 47). An important difference

appears in the stout setæ from the centre of the ventral fascicle. In Plate II., figs. 43 and 44, two of these setæ, one from the right sixteenth foot of each species, are shown side by side. In *Ps. zeylanica* the declivity of the articular surface of the shaft is greater, and below the apex of the shaft there is a very distinct semilunar cusp which is not present in the seta of the same order in *Ps. rigida*. The other setæ show close correspondence, and here, as there, some of them are distinctly bidentate, but the difference noted appears to be constant.

Sthenelais zeylanica, n. sp.—Plate II., fig. 48.

A fragment with extruded proboscis, 15 millims. long, 5 millims. wide, in company with *Hyalinœcia camiguina*, was dredged off Foul Point, Trincomalee, Station XXV., 8 fathoms.

This species is closely allied to *Sthenelais boa*, but differs in several well-marked points. The prostomium carries four eyes in front, two on either side of the stout ceratophore with its aliform lobes (characteristic of the genus); the tentaculum impar borne upon the ceratophore is not very long, about as long as the ceratophore and the prostomium together; the palps are long, nearly as long as the extruded proboscis. The free margin of the latter carries both dorsally and ventrally a row of eleven evenly disposed papillæ.

The scales are carried on the usual segments II., IV., V., VII., IX. * * * * * * * * XXVII., XXVIII., XXIX., &c., becoming consecutive at segment XXVII. In the condition of extruded proboscis the dorsum of the third segment hardly shows, and the first two scales appear to occur on consecutive segments until they are pressed apart. The general character of the scales (their pronounced reniform shape, the tuberculation of the surface and the fimbriation of the margin) resembles that described and figured by Professor McIntosh for *Sthenelais boa* ('Ray Soc. Mon.,' 1900); the fimbriæ of the outer margin are acuminate, others which occur on the posterior margin are blunt; the tubercles are thickly scattered over the whole surface except near the anterior border of the inner lobe and near the corresponding border of the outer lobe; brownish pigment occurs all over the exposed portion of the scale.

The characters upon which I rely for specific differentiation are presented by the parapodia of the body-segments. In *Sthenelais boa* there are four principal groups of setæ, the dorsal plumose capillary setæ, the superior ventral plumose spiniform setæ, the mid-ventral compound bidentate falcigerous setæ, and the inferior ventral compound setæ with articulate bidentate appendix (*cf.* McIntosh, *op. cit.*, 1900). In *Sth. zeylanica* instead of the group of superior ventral spiniform setæ we have, composing this group, a few of the same kind of slender compound setæ with articulate appendix as occur in the inferior ventral group, and the spiniform setæ are not represented in the ventral ramus of the parapodium. The setæ themselves are not sensibly different from those of the corresponding forms in *Sth. boa* (Plate II.,

fig. 48). The ciliated cushions or ctenidia (McIntosh) on the upper surface of the foot beneath the cirriform branchia are the same as in *Sth. boa*, but the disposition of stylodes is different, particularly as regards the two long stylodes which proceed from the base of the ventral cirrus in *Sth. zeylanica* (Plate II., fig. 48).

Sthenolepis, n. gen.

The genera *Thalenessa* and *Leanira* are characterised by the presence of a very small tentaculum impar inserted directly upon the prostomium, not borne upon a ceratophore. The compound setæ of *Thalenessa* are a variety of the falcigerous type with bidentate appendices; those of *Leanira* are spinigerous.

Sthenelais and *Sthenolepis*, n. gen., are characterised by the presence of a long tentaculum impar borne upon a ceratophore which is provided with a pair of spatulate appendages. The compound setæ of *Sthenelais* are falcigerous like those of *Thalenessa;* those of *Sthenolepis* are spinigerous as in *Leanira*.

All the species of *Leanira* described by Professor McIntosh in the "Challenger" collection are to be ranged in the genus *Sthenolepis*. In this genus the scales are generally smooth.

Sthenolepis japonica (McIntosh)—Plate II., fig. 49.

Leanira japonica, McIntosh, '"Challenger" Polychæta,' 1885, p. 154.

A headless posterior fragment of a Sigalionid worm, labelled "*Leanira* sp.," was dredged at Station XXXV., off Galle, 7 fathoms. An anterior fragment of the same species with same locality and date was contained in another bottle in company with *Glycera lancadivæ*.

The different preservation of the two pieces gives them a different aspect, but the structure of the parapodia shows that they belong to the same species. The thin translucent smooth elytra embrace the body so closely as to be inconspicuous; in front they meet in the middle line and overhang the head; further back they leave the mid-dorsum exposed and then approximate again.

The long tentaculum, accompanied by a pair of equally long tentacular cirri, projects straightly and stiffly forwards; the spatulate appendages are nearly as long as the ceratophore; at the base of the latter on each side of the prostomium a small eye is visible from above. The ends of the parapodial rami are furnished with a rich growth of stylodes; the dorsal setæ are very numerous, long, slender, and transversely fringed; from the dorsal end of the ventral ramus a compact tuft of about 20 spinulose simple setæ issues; the rest of the ventral setæ are compound spinigerous, the appendices are not very long and present a peculiar intrinsic laminated structure. Between the cirriform gill and the dorsal fascicle are three ctenidia. The ventral cirrus has a rounded protuberance some distance beyond its insertion (Plate II., fig. 49). The body is slender, the anterior region having a width of 2·5 millims. across the body, 4 millims. across the setæ.

A much smaller complete specimen from the same locality is also contained in the collection and shows to perfection a feature which is present in the larger individual. The anterior setæ of the buccal segment are exceedingly long and slender, as long as the tentaculum and tentacular cirri, and they embrace these appendages in such a manner that the whole complex bears the appearance of a compact flabellum.

There is a great quantity of mucus surrounding the specimens which was apparently produced by the Glycerids with which they were preserved, and this no doubt binds the setæ and tentacles fortuitously together, but the extremely delicate porrect fascicles of long hair-like setæ are highly characteristic. Another point which should be noted is the greater length of the appendices of the compound setæ in the anterior segments. In the smaller specimen there are fewer spinulose or verticillate setæ in the superior fascicle of the ventral ramus, and the stylodes appear to be less numerous; in fact, in a parapodium from the mid-body I only see one verticillate seta as in *Leanira japonica*, McIntosh. Although the Japanese worm retained no scales, yet it seems probable that the Ceylon specimens are co-specific. In these the scales adhere firmly to the body.

Thalenessa digitata, McIntosh—Plate II., figs. 50 to 52.

Thalenessa digitata, McIntosh, "Polychæta," '"Challenger" Rep.,' 1885, p. 140 (off the Admiralty Islands in 16–25 fathoms).
Thalenessa im-thurni, Hornell, 'Ceylon Pearl Oyster Report,' Part I., 1903, pp. 16, 49, and 52.

Taken off Galle (Station XXXVIII.) and off Panadure (Station XLV.) down to 25 fathoms.

Three small frontal antennæ; the lips of the anterior four pairs of setigerous parapodia are produced into conspicuous membranellæ and also carry numerous stylodes; the first five setigers contain setæ with long, jointed appendices, such setæ being numerous in the first four feet, scarce in the fifth, and thereafter absent, only setæ with unjointed appendices being found (Plate II., fig. 50). All these points correspond closely with Professor McIntosh's description and figures.

The elytra do not cover the back; the first two elytra are smaller than the rest, and the first has a smooth margin, destitute of fimbriæ; a typical elytron is sub-triangular in shape, the outer border provided with about a dozen compound fimbriæ, more frequently with four divisions each (Plate II., fig. 51), but there may be as many as six branches, or only three, two, or one. The elytra are attached to segments II., IV., V., VII., IX., * * * * * * * XXV., XXVII., XXVIII., XXIX., &c., becoming continuous at segment XXVII. Cirriform branchiæ are present in all setigerous segments, two clear ctenidia on the dorsal surface of the foot, one attached to the peduncle of the gill. Ventral cirrus long, projecting beyond the foot. No papillæ on the ventral division of a typical foot from the middle region.

Thalenessa oculata, McIntosh, is apparently another form of *digitata*, slightly differing from the type. It is interesting to take note of the differential shifting of

parts which has taken place, for example in such genera as *Thalenessa* and *Iphione*. In the former the palps are concealed below the cirrophores of the tentacular cirri (Plate II., fig. 52); in the latter the cirrophores of the tentacular cirri are concealed below the palps (Plate I., fig. 6).

Thalenessa stylolepis, n. sp.—Plate III., figs. 53 to 56.

Localities:—Station LVII., $11\frac{1}{2}$ to 36 fathoms; and Station LVI., Dutch Modragam Paar, 9 fathoms; specimen incomplete behind; taken out of coral block.

This must be the worm referred to on p. 74 of the 'Ceylon Pearl Oyster Report,' Part I., as *Sigalion mathildæ*.*

The chief characters, which typify a new section of the genus *Thalenessa*, are the possession of a pair of small frontal antennæ and an equally small median occipital antenna; the insertion of the elytra upon high peduncles; and, in the anterior region, the absence of the cirriform branchiæ from the scaleless segments.

Prostomium large, flattened, shield-shaped, with three notches or emarginations, two at the frontal border from which the paired antennæ arise, one at the occipital border from which the tentaculum impar arises (Plate III., fig. 53). Only one pair of eyes was observed occupying a central position behind the frontal emarginations. The cirrophores of the buccal segment are porrect, sub-median and adnate to the prostomium. The line of division between the frontal border and the cirrophores is at the same time the line of concrescence of these structures, so that the antennæ are virtually inserted into the base of the cirrophores, a condition leading to that found in *Sthenelais*, *Sthenolepis* and *Psammolyce*. The palps are long and smooth.

The elytra are pedunculate, the elytrophores rising like stout pillars from the dorsum, as in *Eulepis*; the elytra are firmly attached to the elytrophores; proceeding outwards from the latter below each elytron is a rather long cirriform appendage which does not occur on the intervening segments (segmenta nuda); the latter show a small tubercle in the line of the elytrophores. The elytra are placed on the usual segments up to the 27th, when they begin to be continuously successive. They carry 12 to 13 (or fewer) plumose fimbriæ (Plate III., fig. 56), which project straight outwards from the outer border, followed by a few simple filiform papillæ. The elytra of the first pair are smaller than the following, rounded, not accompanied by cirriform appendage. The remaining elytra cover the dorsum, their inner borders meeting so as to form a tunnel along the length of the body; on the inner side of each elytrophore a small ctenidium projects into the tunnel, a pair of these ctenidia being inclined towards one another in each body-segment (Plate III., fig. 54). As mentioned above, the cirriform branchiæ of *Thalenessa stylolepis* are confined to the elytrophores. The dorsal ramus of the parapodium (Plate III., fig. 54) carries a bundle of numerous long simple fringed setæ, the fringes appearing in side view as a

* The plumose fimbriæ of the elytra exactly resemble those of *Sigalion mathildæ* as figured by Professor McIntosh (1900).

series of projecting overlapping scales ; mediad of the dorsal fascicle the simple setæ are shorter and hyaline. The ventral ramus carries a superior bundle of simple whorled setæ, the verticillate tract short. All the remaining ventral setæ are of the compound falcigerous type, bearing very long, many-jointed, tapering, bidentate appendices, the number of joints being as many as ten. The compound setæ of the middle group are characterised by the possession of squamose (fringed) shafts, while the more slender setæ of the inferior group have plain shafts. A parapodium from the posterior region (near the 60th segment) shows the dorsal ramus projecting clearly beyond the ventral, and in the ventral fascicle, in addition to the compound setæ with the long, jointed, flexible appendices, there are two stout setæ with short unjointed appendices provided with a gaping beak (Plate III., fig. 55). Between 50 and 60 segments are present in the imperfect specimen described above, which is 35 millims. long with width of 3 millims. without the setæ, 4 millims. over the setæ.

Family: PHYLLODOCIDÆ.

Anaitis zeylanica, n. sp.—Plate III., figs. 57 to 60.

Locality :—South of Manaar Island, 8 to 9 fathoms. One specimen, proboscis retracted.

The dorsal phyllodes are broadly ovate (cordate-lanceolate) and pedunculate, as they are in a dozen other species. Head rounded ; eyes large ; tentacular cirri normal, elongate. Proboscis (dissected) consists of two well-separated portions, a thin-walled proximal or adoral portion densely crowded with papillæ not serially disposed ; a thick-walled distal portion with six prominent rows of large subtriangular papillæ, six or seven in a row.

Setæ, ten in a parapodium, the shaft terminating in a triangular apex fringed at the sides and articulating on one side with a long flagelliform strongly serrulate appendix (Plate III., fig. 57). Anal cirri (one preserved) of moderate length, acuminate with stout basal portion. Body slender, length 38 millims. ; total width under 2 millims.

The setæ appear heterogomph in side view, homogomph in frontal view (Plate III., fig. 58). I am afraid they offer no reliable diagnostic character, unless it is their size. In this, however, as in other points they resemble the setæ of *Phyllodoce sancti-josephi.* The shape of the head and of the phyllodes is shown on Plate III., figs. 59 and 60.

Carobia castanea, Marenzeller.

Marenzeller, 'Südjapan. Ann.,' i., 1879, p. 127 (p. 19 of reprint).

This species is distinguished from other Oriental Phyllodocidæ by its deep red colour.

The red dorsal phyllodes are cordate and the setæ are distinguished from all others

in this collection by their rather short appendices destitute of serrulations and the wide, nearly horizontal articular end of the shaft, as figured by von Marenzeller.

Notophyllum laciniatum, n. sp.—Plate III., figs. 61 and 62.

Station V., off Chilaw Paar, Gulf of Manaar, 11 fathoms. One specimen.

This Phyllodoceid worm is characterised by a relatively short and thick body and by the possession of broad closely imbricating scales or phyllodes (foliaceous dorsal cirri); the anterior phyllodes conceal the occipital region of the head, meeting across the middle line, the rest leave the mid-dorsum exposed. There are as many as ninety segments. The specimen measures about 20 millims. in length and 3 millims. in breadth.

The head is simple, with two large eyes in the posterior half, between which arises a brown-tinted tentaculum impar. The somewhat fusiform antennæ arise between the eye-region and the anterior border, and the fusiform palps, with rather long terminal flagellum, arise nearer the middle line from the under side of the frontal region. The left antenna was lost from the specimen. The four pairs of tentacular cirri are closely aggregated in the cephalic region, only two of them are seen from above, the second and fourth, the latter being the longest. The first cirrus is more massive than the others.

The great character of the species is given by the presence of three cirriform occipital or nuchal lappets, which hang backwards on each side from the back of the head (Plate III., fig. 61). This feature also occurs in *Phyllodoce multicirris*, Grube ('Ann. Semp.,' p. 100), which is clearly a closely allied species, differing in the structure of the head, especially in the decided possession of four eyes. The setæ and phyllodes also exhibit minor differences. Each occipital lappet has a pale border and a brown centre. The dorsal phyllodes have the same shape and arrangement as figured by Grube for *Ph. multicirris*, but they do not show the round surface markings of that species. The ventral phyllodes also have the same peculiar disposition, inserted high up near the extremity of the parapodium and lying outspread behind the pharetra setarum.

In the setæ the articular end of the shaft shows a character of its own. There are as many as 21 setæ in a ventral fascicle from the anterior region; most of them are broken. In optical section the ends of the shafts appear deeply excavate, the articular fossa bounded by stout refringent walls (Plate III., fig. 62). The dorsal ramus is represented by the lobe upon the summit of which the dorsal phyllode is inserted; it is penetrated by a single slender acicula. The appendices of the compound setæ are rather long and minutely serrulate.

Phyllodoce dissotyla, n. sp.—Plate III., figs. 63 to 66.

Station V., off Chilaw Paar, Gulf of Manaar, 11 fathoms. One specimen, 25 millims. long by 1 millim. broad; proboscis not extruded.

The head is longer than broad; the antennæ do not stretch back to the eyes; the eye shows a clear lens (Plate III., fig. 63). There are four pairs of long tentacular cirri of normal form. The dorsal phyllodes are rounded, not lanceolate, and strongly pedunculate. The setæ, 18 in a fascicle, are heterogomph, the articulation of the appendix distinct; the appendix with serrulate edge (Plate III., figs. 64 and 65).

The dominant specific character was ascertained by removing and opening the retracted proboscis, the adoral portion of which is beset with longitudinal rows of rounded normal papillæ; in two of the rows, probably median dorsal and median ventral (since they are separated from one another by normal rows), there are three large triangular papillæ placed one behind the other, with normal papillæ in front and behind in the same rows. These modified papillæ are denser than the rest and are noticeable under low magnification with a simple lens (Plate III., fig. 66). They are quite definite, two sets of three on opposite sides of the proboscis.

The phyllodes and setæ are also characteristic, but the determining character is given by the papillæ of the proboscis.

Phyllodoce foliosopapillata, Hornell—Plate III., figs. 67 to 69.

'Ceylon Pearl Oyster Report,' Part I., 1903, p. 16 and p. 28, "Yellowish green Phyllodocid."

Station XVII., outside Periya Paar, 11 fathoms.

The specimen, which is incomplete behind, has a length of 135 millims. (141 millims. with extruded proboscis); about 207 segments; ventral width between the parapodia 2 millims.; over the parapodia 5 millims. The proboscis is firm and sexangulate; towards the base it is traversed by transverse rugæ, and behind these, at the level of the head on each side, there are six rows of transversely elongate, foliate papillæ, 5 or 6 in the first row, 8 or 9 in the second, 10 in the third, and again decreasing below; at the free margin I counted 14 or 15 rounded papillæ (Plate III., fig. 67). The foliaceous dorsal cirri, which may be called phyllodes to distinguish them from the elytra of the Aphroditidæ, are borne upon broad peduncles to which they are strongly adherent. In this specimen the phyllophores are filled with ova (Plate III., fig. 68).

There are as many as 25 compound setæ in a parapodium. The long flexible spiniform appendices are serrulate along one border, but in some of them the serrulations are obscure or even obsolete. The setæ differ from those of other species in the presence of a long stout spur at the head of the shaft, which sometimes projects considerably beyond the neighbouring denticulations, even more so than in the example figured (Plate III., fig. 69).

Closely apposed to the sides of the prostomium is a pair of lateral nuchal organs (Plate III., fig. 67). The prostomium is broader than long, deeply emarginate behind, and in the notch there is an occipital papilla, such as occurs also in *Phyllodoce madeirensis* and other species.

The insertion of the four pairs of tentacular cirri is the same as in *Ph. madeirensis*, namely, on each side :—

Segment I., one tentacular cirrus ;
,, II., two tentacular cirri ;
,, III., one tentacular cirrus and a cirrus ventralis foliaceus.

The first appearance presented is that of two cirri in the first segment, but closer examination showed that this appearance is deceptive. The longest is the dorsal cirrus of the second segment, stretching back over eleven segments.

Phyllodoce macrolepidota, SCHMARDA—Plate III., figs. 70 and 71.

SCHMARDA, 'Neue Wirbellose Thiere,' ii., 1861, p. 83, Taf. xxix., fig. 229.
Phyllodoce tenuissima, GRUBE, 'Ann. Semp.,' 1878, p. 95.

Locality :—Galle Habour, on oyster cage. One specimen.

Body very long and slender, 200 millims., with a width of 3 millims. in front, over the setæ ; more than 350 segments. The proboscis is only half extruded, and this portion is inflated and soft ; it carries six longitudinal rows of broad, flattened, arcuate, dark-coloured papillæ on each side in front of the head-region, 8 to 10 papillæ in a row, and, in addition, a median dorsal row of six papillæ. The general arrangement of the papillæ and the presence of the median row are features which characterise *Ph. madeirensis*, LANGERHANS, of which this may be an Oriental representative, but it has nearly three times the length and about twice as many segments as in the type-species of LANGERHANS. There are 17 setæ in a parapodium (Plate III., fig. 70) ; they do not offer any striking character (Plate III., fig. 71). The head is about as long as it is broad, with rather large eyes in the centre of the posterior cephalic convexity on each side ; it is acutely notched behind, but the specimen does not show a nuchal papilla. There are two rather short, stout, subulate anal cirri.

Phyllodoce sancti-josephi, GRAVIER—Plate III., figs. 72 and 73.

GRAVIER, "Ann. Polychètes de la Mer Rouge," 'Arch. Mus. Paris (4 ser.), ii., 1900, p. 196.

Station V., off Chilaw Paar, Gulf of Manaar, 11 fathoms. Two specimens.

These worms differ from the type in the shape of the head and in the apparent absence of an occipital papilla. The widening of the head is correlated with the extrusion of the proboscis, and the occlusion of the papilla may be due to the same cause. One of the specimens has a length of 55 millims. and a total width in front of 2 millims.

The proboscis in its general consistency and in the presence of a posterior rugose portion resembles that of *Ph. foliosopapillata*, but the papillæ, of which there are six rows on each side, extend over the rugose region in front of the head (Plate III., fig. 72). In the second specimen the proboscis shows six prominent angulations in front of the rugose portion.

The head itself, under the condition of extruded proboscis, is about as broad as long and not deeply notched behind. On each side of the prostomium there is a prominent lateral nuchal papilla. The phyllodes resemble those of *Ph. macrolepidota* in shape and proportion, the dorsal phyllode being distinctly pedunculate and its axis occupied by a rete mirabile, from which radial vessels proceed to the margins. The parapodium carries twelve setæ of normal type (Plate III., fig. 73), though, as shown by M. Gravier, the number varies within narrow limits in different regions of the body. The number which I have given holds good for the mid-region. A foot from the posterior region has sixteen setæ.

Pterocirrus ceylonicus, Michaelsen.

This species is well characterised by the five long slender subequal prostomial appendages, longer than the prostomium. The remarkable winged ventral cirrus of the second segment which, seen from above along its thickened dorsal border, looks like an ordinary tentacular cirrus, is a generic feature of first importance. The dorsal phyllodes are more lanceolate than that shown in Dr. Michaelsen's figure, "Polychäten von Ceylon," 'Jahrb. Hamburg. Wiss. Anstalt,' 1892, ix., 2, p. 103, otherwise I have nothing to add to his description. The colour of the preserved specimens is dark greenish-brown. Locality :—Ceylon Seas.

Family : HESIONIDÆ.

Hesione ceylonica, Grube.

Grube, "Ann. Ceylon" (Holdsworth coll.) 'P. Zool. Soc. London,' 1874, p, 327.

Locality :—Numerous specimens from various stations.

This is probably a geographical form of *Hesione splendida*, Savigny, which is characterised by the possession of one pair or frontal antennæ; eight pairs of tentacular cirri; sixteen pairs of uniramous parapodia; four distinct eyes; pigment disposed more or less in longitudinal bands or streaks. Savigny was in error regarding the minute antennæ, and the illustrations do not correspond with the text in certain particulars, hence confusion has arisen.

The Ceylon specimens range in length of body from 9 millims. to 36 millims. ; in the latter case the ventral width between the parapodia is 4 millims., over the setæ 11 millims. In all cases the full number of setigerous segments, namely 16, is present. The extruded proboscis shows a median dorsal callosity or hard papilla (not seen in the smallest specimen) a short distance from the base, like that figured by Audouin and Milne-Edwards (1834) in *H. pantherina*. The compound falcigerous setæ have bidentate appendices with a spiniform guard arising below the denticulations. The guard may be worn away.

A specimen of 14 millims. length had a ventral width between the parapodia of 2 millims., over the setæ nearly 5 millims.

Hesione genetta, Grube. (See Grube, 'Ann. Semp.,' 1878, p. 104.)

One specimen from Chilaw Paar, Station LXIX.

This species is distinguished from the members of the *splendida* group by its very characteristic and enduring pigmentation. At the junction of the first and second setigerous segments there is a broad dark transverse band passing from one side to the other across the convex dorsum. Behind this band the segments are marked by transverse brown spots which are sometimes confluent. The cuticle is highly iridescent; the body flexed ventrally and the ventro-lateral borders elevated, leaving a median neural groove between them. The prostomium is quadratic; two frontal notches from which the minute antennæ arise; eyes barely visible. The body is shaped like that of *H. reticulata*, von Marenzeller (South Japan), and resembles the body of a caterpillar, as remarked by von Marenzeller. Length 13 millims., inclusive width 3 millims.

Irma limicola, n. sp.—Plate III., figs. 74 to 76.

This species is founded upon a single example which occurred in one of the mud-tubes of *Loimia montagui* from Palk Bay. It is not very well preserved in consequence of having been trapped in such a narrow recess. Its length is 20 millims., width 3 millims., with upwards of 50 segments.

The head is transverse, the eyes widely separated, the anterior and posterior eyes of each couple crescentic and closely approximated. From the frontal border of the prostomium on each side two equal cephalic appendages (antennæ and palps) curve backwards, lying over the eyes and sides of the prostomium. The biannulate proboscis is extruded. No tentaculum impar could be observed. Six tentacular cirri are present on each side of the buccal segment, placed in a dorsi-ventral manner, the upper and lower of the group being shorter than the intermediate.

The dorsal ramus of the parapodium is intimately connate with the cirrophore of the dorsal cirrus into which an acicula extends, and from a slight protuberance on the lower side of the cirrophore a bundle of very fine capillary setæ emerges (Plate III., fig. 74). The compound setæ of the ventral ramus are numerous, about fifty in each fascicle. They are falcigerous, carrying very long appendices curved at the tip and bidentate, the apical tooth frequently connected with the minor tooth by a limbus. The superior setæ of the ventral ramus have appendices about one-half shorter than the average; the inferior setæ, *i.e.*, the most ventrally placed setæ, carry quarter-sized appendices (Plate III., figs. 75 and 76). The relations of the dorsal and ventral cirri and the lip of the parapodium are shown in the figure (Plate III., fig. 74). Repeated examination failed to reveal any trace of a tentaculum impar in *Irma limicola*. In this respect it approaches the genus *Castalia*, Sav., as amended by M. Sars ('Christ. Vid. Selsk. Forh.,' 1861, p. 88), but there are no coronary papillæ on the proboscis and no jaws.

The definition of *Irma* should be modified as follows :—

Proboscis nuda; palpi biarticulati; antennæ 3 (interdum 2 observatæ); oculi 4; cirri tentaculares 12; pedes quasi biremes; ramus dorsalis vestigialis cum articulo basali cirri dorsalis connatus, setas dorsales capillares gerens aut nullus; setæ ventrales compositæ falcigeræ; aciculæ binæ.

The fact of an acicula passing into the cirrophore indicates the primitive biramous nature of the foot in those species where dorsal capillary setæ do not occur, exactly as in the analogous case of *Podarke*, Ehlers. The absence of a median antenna in *I. limicola* is puzzling, and will remain so until more material is obtained. The species described by me as *Oxydromus aucklandicus* ('"Southern Cross" Collections,' London, 1902, p. 281) should be transferred to the genus *Irma* as now defined.

Family: SYLLIDÆ.

Typosyllis taprobanensis, n. sp.—Plate III., figs. 77 and 78.

Localities:—East side of Cheval Paar; and South-west Cheval Paar, Gulf of Manaar.

This is a variable species, one specimen seemed to resemble *T. variegata*, the next *T. krohni*, the differences being in part substantial, in part due to the fact that the pharynx of the one was on the point of being projected, that of the other was retracted completely.

Antennæ and cirri moniliform; in the first specimen (length 19 millims., width 1·5 millims.) the paired and unpaired antennæ were about equal in length to each other and to the palps, the paired rather slenderer than the impar, shorter than the dorsal cirri; the latter, not deciduous, longer alternating with shorter and slenderer; the first ventral tentacular cirrus slender, not much longer than the palps; head transverse, partially concealed below the buccal segment; pharynx, on the point of projection from the mouth, lined by thick dark-brown cuticle (showing dark purplish-black through the skin) carrying a subterminal dorsal tooth coloured the same as the chitinous intima; proventriculus, with about 37 rows, finely tessellated, glistening whitish with delicate flush.

In the second specimen the median antenna was long, showing 36 joints; most of the dorsal cirri were lost, that of the 5th setiger showed 42 joints, that of the 64th setiger upwards of 30 joints; the pharynx and proventriculus, seen by transparency, exactly resembled those of the first specimen and decided the specific identity, but were differently placed, being retracted; the pharynx extended from the 7th to the 15th setigerous segment, the proventriculus from the 15th to the 25th setigerous segment; colour of the first 24 setigerous segments:—two brown transverse bands in each segment; total number of segments 150; length 30 millims.

The setæ of both corresponded in general characters, differing in a manner shown in the figures (Plate III., figs. 77 and 78). In the anterior segments there are about

12 to 16 compound falcigerous bidentate setæ lying below 5 aciculæ; the aciculæ become reduced to 3 and posteriorly to 2; the setæ also undergo changes, the shaft becoming stouter and the appendix shorter; the shaft further assumes a characteristic dilatation of varying intensity below the joint (Plate III., figs. 77 and 78).

The anal cirri showed 24 joints; no median caudal process was observed. The head of the second specimen was normal, rounded, not transversely elongate, the latter condition apparently resulting from the commencing extrusion of the pharynx. The palps are quite separate, with distinct subfrontal insertions, a wide proximal half and a narrower distal halt.

In *Typosyllis variegata*, according to VON MARENZELLER,* the palps are fused together at the base. The Ceylon species would appear to be related to *T. krohni*, as described by LANGERHANS.† The difference noted above in respect of the shafts of the setæ may be correlated with the difference of age and size of the specimens of *T. taprobanensis*.

Haplosyllis spongicola (GRUBE)—Plate III., figs. 79 and 80.

GRUBE, 'Arch. Naturg.,' 1855, p. 104; MARION et BOBRETZKY, 1875, 'Ann. Marseilles,' p. 24.
Syllis hamata, CLAPARÈDE, 1868; LANGERHANS, Madeira, 1879, 'Z. f. w. Z.,' xxxii., p. 527; ST. JOSEPH, 'Dinard,' 1886, part i., p. 142; 1895, part iv., p. 185.
Syllis violaceo-flava, GRUBE, 'Ann. Semp.,' 1878, p. 115; see also LANGERHANS, Madeira, part iii., 'Z. f. w. Z.,' xxxiv., p. 128.

A small specimen, 4·5 millims. long, was taken from between the whorls of the operculum of a large Serpulid [*Pomatostegus actinoceros*], off Panadure, Station XLV., 25 fathoms.

Over 40 setigerous segments; setæ brittle, many of them with the tips broken off. The proventriculus is long, occupying segments 13–25, but the body is contracted. On examining the specimen *in toto*, it is common to see two hamate unguarded acicular setæ projecting from a parapodium, one of which is stronger than the other; both of these setæ have a bidenticulate apical tooth as figured by MARION and BOBRETZKY, and by LANGERHANS. (In *Haplosyllis djiboutiensis*,‡ GRAVIER found, in one individual, the apical tooth of the stronger seta simple.) The pharynx is armed in front with a single conical tooth surrounded by a crown of ten soft papillæ (Plate III., fig. 80). The head is shown in Plate III., fig. 79.

Syllis gracilis, GRUBE (1840).

(*Cf.* ST. JOSEPH, "Ann. de Dinard," part i., 'Ann. Sci. Nat.' (7) i., 1886, p. 158; part iv., t. xx., 1895, p. 190.)

Locality:—South-west Cheval Paar. Three specimens.

1. About 180 segments; length 45 millims.; body contorted; diameter uniform,

* 'Adriat. Ann.,' ii., 1875, p. 147.

† "Wurmfauna Madeira," i., 'Zeit. f. wiss. Zool.,' xxxii., 1879, p. 529.

‡ GRAVIER, "Ann. Mer Rouge," 1900, 'Arch. Mus. Paris' (4) ii., p. 147.

about 1 millim. without feet, 2 millims. inclusive. Anterior setæ compound, falcigerous, bidentate, in about 30 segments; thereafter simple furciform setæ; in the posterior segments some of the furciform setæ become quasi-compound. Dorsal cirri of about 40 anterior segments long, with a tendency to alternate longer and shorter; afterwards they become shorter, subfusiform, still alternating. Tentaculum impar with 27 joints; paired antennæ, about 16 joints; dorsal tentacular cirrus, 18–20 joints; first dorsal cirrus, 34 joints; posterior dorsal cirri, 8–12 joints. Pharynx black in segments 3–20; proventriculus in segments 20–28.

2. Length 15 millims., 83 segments followed by about a dozen regenerating segments showing small compound setæ of the usual type. Compound setæ in anterior 28 segments.

3. Length 22 millims.; segments 118; compound setæ in 28 anterior segments; in segments 29–90 simple furciform setæ; in segments 91–118 the falcigerous bidentate setæ re-appear. Pharynx brown in segments 1–13; proventriculus 14–20. Tentaculum impar moniliform, 18 joints; dorsal cirrus of first setiger longest, with 20 joints.

Autolytus orientalis, n. sp.—Plate IV., figs. 81 to 84.

Locality:—Found in plankton, 2nd and 3rd March, 1903, North-east Cheval. Several stoloniferous specimens; total length 10 to 20 millims.

In the example figured (Plate IV., fig. 81) there are 29 setigerous segments in the anterior or parent individual. The parapodia contain two aciculæ and numerous, upwards of 20, compound falcigerous setæ; the head of the shaft is laciniate and the appendix is minutely bidentate and minutely fringed (Plate IV., fig. 84). The dorsal cirri are rather short, lanceolate, petaloid, with strong basal articulation. The second dorsal cirrus, *i.e.*, the cirrus of the first setiger, is the longest. The rounded reduced palps, joined together in the middle line along their own length, are only visible from below (Plate IV., fig. 83). The pharynx is long and has a sigmoid flexure; it is armed in front with a circle of 44 denticles, larger and smaller irregularly alternating (Plate IV., fig. 82). The proventriculus shows 28 glandular rows.

FAMILY: NEREIDÆ.

Nereis indica, KINBERG.

KINBERG, 'Annulata nova—Nereidum dispositio nova,' 'Öfv. Akad. Forh.,' 1865, p. 169.

Locality:—Galle, from buoy; one female containing ova.

Length 50 millims., inclusive width 4·5 millims. Tentacular cirri not long, reaching to third segment; antennæ $\frac{3}{4}$ length of prostomium; palps long with narrow terminal appendix; eyes large, equal, the posterior rather closer together. Body incomplete behind, 77 setigerous segments.

Feet subequal; dorsal cirri of anterior segments about twice as long as the blunt dorsal ligule; ventral cirrus not reaching the tip of the ventral ligule; in the middle segments the neuropodia and the bases of the cirri become membranous, the dorsal

ligule becomes elongate and acuminate,* the dorsal cirrus exceeding it by about one-fifth only; in the posterior segments the dorsal cirri are upwards of four times the length of the dorsal ligule. Dorsal setæ homogomph spinigerous; superior ventral setæ homogomph spinigerous and heterogomph falcigerous; inferior ventral setæ heterogomph spinigerous and heterogomph falcigerous. The shafts of all the setæ are striated and all the appendices are strongly fringed (setulose); the falciform appendices are entire at the apex, not bidentate.

The proboscis was retracted and was dissected out:—I., 1; II., 12–12 (oblique acervi); III., 10 (triangular acervus); IV., 15–15 (three unequal rows); V., 0; VI., 6–6 (irregular); VII. and VIII., biserial, anterior row large alternating paragnaths; paragnaths of the posterior row half as large and one and a half times as numerous as those of the front row.

Nereis unifasciata, n. sp.—Plate IV., figs. 85 to 88.

Locality:—South-east Cheval Paar.

A small Nereid (length 11 millims., incomplete behind) characterised by the presence of a dark brown collar across the whole of the dorsum of the second setigerous segment. The buccal and the first setigerous segments are pale brownish at the sides, but there is no band across them. Commencing from the intersegmental groove between the fourth and fifth setigerous segments there are about twelve pairs of small intersegmental brown spots on the back. The feet are equal and resemble those of *Ceratonereis pectinifera* (p. 272) in the general proportions of parts (Plate IV., figs. 85 and 86). The two worms were collected at the same time and place.

The distribution of the setæ in the foot is as follows:—Dorsal, homogomph spinigers; superior ventral, homogomph spinigers and heterogomph falcigers; inferior ventral, heterogomph spinigers and falcigers. The heterogomph spinigers are not completely heterogomph, but, at least in the middle and posterior segments, present a condition which might be described as hemigomph (Plate IV., figs. 87 and 88). This small detail affords the only real distinction between the armature of the feet of this species and that of *Ceratonereis pectinifera*. The proboscis was not extruded, and, although as a rule I do not attempt the description of small Nereids unless the proboscis is extruded, I was anxious to test the specific value of the colour-markings and of the setæ. The dissected proboscis showed paragnaths in the adoral division, those of the order VI. in small acervi, of VII. and VIII. in a single row as in *Nereis trifasciata*, GRUBE. It is therefore not a *Ceratonereis*.

I cannot state any differences between the armature of the proboscis of this species and that of *Nereis trifasciata*.† The fact that such a minute detail as the presence

* The inferior lip of the notopodium is also produced as a ligule, the inferior dorsal ligule, resembling the superior ligule throughout, but rather shorter.

† Except that the maxillæ show seven teeth.

of hemigomph instead of homogomph spinigers in the inferior ventral fascicle is sufficient to indicate fundamental divergence is interesting. The third tentacular cirrus stretches back to the end of the seventh segment as in *N. trifasciata.*

Nereis ehlersiana, Grube. (Grube, 'Ann. Semp.,' 1878, p. 71.)

Locality :—Station LXIX., Chilaw Paar.

The anterior portion of the body comprises 15 segments (14 setigerous); the dorsal cirri of the first seven setigerous segments are modified, unequally elongate and foliaceous. A normal parapodium from the anterior region shows reduced rounded ligules, moderate dorsal cirrus much longer than its ligule, short ventral cirrus; dorsal setæ homogomph spinigerous; superior ventral homogomph spinigers and heterogomph falcigers; inferior ventral heterogomph falcigers.

Ceratonereis falcaria, n. sp.—Plate IV., fig. 89.

Locality :—South-west Cheval Paar, two specimens.

About 107 segments with an even diameter of 2·5 millims. up to the region of the 55th segment, then rapidly attenuating; length 27 millims. Frontal border notched so that the antennæ are borne upon ceratophores as in *C. tentaculata*, Kbg., and *C. excisa*, Gr. Eyes large, in a rectangle. Tentacular cirri moderately long; dorsal cirri more than twice as long as the dorsal ligules; ventral cirri of the two middle quarters of the body with basal lobules.

The distinctive character of the species is afforded by the setæ. In the first sixteen segments the setæ of the dorsal fascicle are homogomph spinigerous; of the superior ventral fascicle homogomph spinigerous and heterogomph falcigerous; in the inferior ventral fascicle heterogomph spinigerous and heterogomph falcigerous; the shafts are striated, the appendices fringed and the falciform appendices are simple, not bidentate. After this the dorsal setæ undergo a change, becoming homogomph falcigerous with a deeply set, strongly bidentate appendix without guard (Plate IV., fig. 89). Transitional forms between the two kinds of dorsal setæ are to be observed, namely, setæ in which the appendix is shorter and stouter than in the normal spinigerous setæ. Paragnaths :—I., 0; II., 5–5; III., 7 (in one row); IV., 10–10. Maxillæ with about six denticulations. In the character of the paragnaths this species approaches *C. vulgata*, Kinberg, from Honolulu. The change of dorsal setæ from spinigerous to falcigerous is remarkably diagnostic.

Ceratonereis pectinifera, Grube—Plate IV., figs. 90 and 91.

Grube, 'Ann. Semp.,' 1878, p. 66.

Locality :—South-east Cheval Paar.

A small Nereid, 17 millims. in length, almost the only one in the collection with the proboscis extruded. The systematic importance of the paragnaths of Nereidæ is well known, and a particular illustration of it is afforded by this species in comparison

with *Nereis unifasciata* (q. v.). Antennæ shorter than proboscis, eyes in a wide trapezium or subrectangle; third tentacular cirrus reaches back to seventh segment. Posterior segments with brown glandular tracts on the dorsal sides of the segments and on the bases of the parapodia (Plate IV., fig. 91). Feet equal, dorsal cirrus longer than dorsal ligule; in the anterior feet there are prominent labia pharetrarum (Plate IV., fig. 90).

Dorsal setæ homogomph spinigerous; superior ventral setæ homogomph spinigerous and heterogomph falcigerous; inferior ventral setæ homogomph spinigerous and heterogomph falcigerous. The paragnaths do not quite agree with GRUBE'S formula, but I think nearly enough to determine the species:—I., 0, II., a double oblique row, 3 or 4 larger in the hinder row, 4 or 5 smaller in the front row; III., 1; IV., an acervus of 8, two very small in front, three rather larger in the middle and three still larger behind. The actual length of the third tentacular cirrus is about 2 millims.

The Ceylon specimen seems to agree with GRUBE'S *C. pectinifera* in all characters except the mouth-parts and with *C. lapinigensis* in respect of the mouth-parts. The maxillæ show 5 blunt teeth. Perhaps the two forms are co-specific. The arrangement of the setæ in the foot is not described by GRUBE in either of his species. The peculiarity here is the occurrence of homogomph spinigerous setæ as well as heterogomph falcigers in the inferior ventral group. In *Ceratonereis costæ*, according to EHLERS ('Borstenwürmer,' p. 525), there are only falcigerous setæ in the inferior ventral group. It is uncommon to find homogomph spinigers in the inferior ventral fascicle.

Platynereis bengalensis, KINBERG—Plate IV., figs. 92 to 94.

Mutturaratu Paar, March 29. One specimen, incomplete behind, 45 setigerous segments, width over setæ 4 millims.

Description of a foot from anterior region (9th foot of right side):—Dorsal cirrus normal, $2\frac{1}{2}$ times the length of the dorsal ligule, which is short, rounded, and bulky; inferior dorsal ligule like the superior; ventral ligule like the dorsal ligules; ventral cirrus not reaching the end of the ventral ligule. Dorsal setæ homogomph spinigerous; superior ventral setæ homogomph spinigerous and heterogomph falcigerous (appendices simple, fringed, short); inferior ventral setæ heterogomph, spinigerous and falcigerous.

Description of the 44th foot of right side:—A large brown glandular tract divided into two portions at base of dorsal cirrus; ligules obtusely pointed, more than half the length of the dorsal cirrus (ventral ligule rather shorter than the two dorsal ligules and narrower at its base). Dorsal setæ homogomph spinigerous and falcigerous; superior ventral homogomph spinigerous and heterogomph falcigerous; inferior ventral heterogomph spinigerous and falcigerous. The appendix of a dorsal falciger is guarded and unfringed; its extremity is boldly hooked, and at the vertex of the hook there is a small tooth in front of which the guard makes another slight projection (Plate IV.,

fig. 92). The appendix of a superior ventral falciger in this foot is fringed along its lower portion, guarded along its upper half (Plate IV., fig. 93). The appendices of the other ventral falcigers of this foot and of the other feet, and also in many other species of Nereidæ, are minutely guarded quite at the apex beyond the fringe; a double contour at this point indicates a rudimentary guard, as may be realised by comparison with the structure of the superior ventral setæ here described (Plate IV., fig. 93).

The parapodium (44th) from the middle region of the body described above closely resembles that figured by Gravier for his *Platynereis insolita* ('Arch. Mus. Paris' (4), iii., 1901, p. 198), and, in fact, could not be distinguished from it. The only difference seems to lie in the structure of the appendices of the dorsal falcigerous setæ which have a smooth rounded vertex without any prominence in *P. insolita* (*loc. cit.*, p. 198, fig. 206). The same setæ with tooth on the vertex occur also, two in number, in the 19th foot of the Ceylon specimen.

The tentacular cirri are long, the third pair extending over 16 segments. The proboscis was retracted and had to be dissected out:—Paragnaths of the orders I., II., III., and V. absent; of the order IV. (Plate IV., fig. 94) in several more or less complete rows (as in the type). Antennæ as long as the palps, eyes in a trapezium.

Family: ONUPHIDÆ.

Diopatra amboinensis, Aud. & M.-Edw.—Plate IV., figs. 95 to 97.

Station V., off Chilaw Paar, 11 fathoms.—One specimen with tube.

Another empty tube was taken from the Muttuvaratu Paar, 29th March, 1902.

The tube is characteristic, encrusted with unequal pieces of coarse broken shells which stand out at right angles to the wall of the tube, being attached thereto by one edge, giving the impression of pieces of shell threaded together; some of the fragments are nearly entire shells, as much as $\frac{3}{4}$ inch long, the majority are smaller; seaweed may grow on the shelly covering; the tube is from 3 to $3\frac{1}{2}$ inches long, and presents a tabulate appearance owing to the disposition described above.

The body of the specimen, which is incomplete behind, is flattened, 4 millims. wide. The dorsal side is brown coloured, with a dark hæmal line and a shining cuticle; the lateral parapodial tracts show up whitish in the preserved state; ventrally there is a pale neural tract flanked by two broad brown submedian bands, followed on the outside by the series of broad whitish ventro-lateral tori or cushions which resemble the uncinigerous tori of a Terebellid without the uncini, and doubtless serve to facilitate the passage of the worm up and down its tube. The first five setigers are much larger than the rest, with a ventral and porrect inclination, and carry ventral cirri instead of tori. The spiral penicillate branchiæ commence on the sixth segment (*i.e.*, fifth setigerous segment). Towards the fortieth segment they become reduced and finally cease in the region of the sixtieth; in the mid-region they are more than twice the length of the stout, subulate dorsal cirri.

The prostomial tentacles are somewhat pigmented, especially at the base, where the long flagelliform portion is inserted into the 10- or 12-ringed basal peduncle. The frontal antennæ have a stout pigmented basal portion, followed by a narrower apical portion, the whole as long as the peduncle of the lateral tentacle. The tentacular cirri arising from the border of the single apodous buccal segment are as long as the peduncles of the submedian tentacles, or slightly longer. The eye-tracts occur behind the submedian tentacles. The broad rounded palps have a teat-like apex. In the protruding jaws I counted 8 teeth on the right saw, 7 on the left, about 10 on the right arc, 8 or 9 on the left, and 5 teeth on the left impar. The lower jaw-plates or laminæ ventrales have thin white calcareous end-pieces with simple border and rounded divergent apices; the mandibles have the usual form (Plate IV., fig. 95).

This species is closely related to *Diopatra neapolitana*. Its differentiation from any other species of the genus will probably depend upon the character of the setæ in the anterior modified parapodia, about which our information is rather deficient, so far as I am able to judge from the literature of *Diopatra*. It is equally closely related to *Diopatra semperi*, Grube ('Ann. Semp.,' p. 282 = *D. luzonensis*, p. 138), but the latter has very short frontal antennæ and the calcareous caps of the lower jaw-plates are trilobate; the anterior setæ are not described. The identification of the present species cannot be considered final until fresh material for comparison is obtained from Amboina or adjacent parts. A preparation of the first left foot of *D. amboinensis* from Ceylon shows about 18 setæ projecting. There is a dorsal group of about six long, simple, curved acuminate, non-limbate capillary setæ; the rest have a bidentate apex beyond which the pointed guard projects (Plate IV., fig. 96-97). The anterior appendages possess other characteristic features besides the setæ which they carry. The lips of the orifice of the pharetra setarum are triangulate, an anterior short truncate border followed by a long stout cirriform posterior median lobe and a smaller ventral ligule; I do not know of any other species of *Diopatra* in which this third ligule has been described. Sometimes it is appressed against the median lobe and so concealed from view on the slide, but it can be found with a simple lens on the body of the worm. In Grube's description of *D. semperi* (= *D. luzonensis*) the diagnostic features of the anterior modified parapodia are not given. From the parapodia of the mid- and hind-body two aciculæ project with bifid apices as figured by Ehlers ('Borstenwürmer,' Taf. xii., fig. 15) for *D. neapolitana*. The scalprate setæ of the posterior segments have numerous fine denticulations (over 20), whereas according to Ehlers they are few (about 8) in *D. neapolitana*. The filaments of the branchiæ are long.

Onuphis basipicta, n. sp.—Plate IV., figs. 98 and 99.

Station XXXV., Galle, 7 fathoms. One specimen in company with *Glycera lancadivæ*. Length 23 millims., width 1 millim.

Patches of brown pigment on the bases (ceratophores) of the antennæ; submedian

antennæ longer than the median (tentaculum impar); ceratophore of the median antenna normal, nearly one-third the total length of the antenna, less than one-half the length of the ceratophores of the submedian antennæ which are nearly one-half the total length of these appendages; ceratophores of the lateral antennæ about three-fourths the length of the submedian ceratophores, about two-thirds of the total length of the lateral antennæ.

The above proportions, the moderate length of the median and the considerable length of the submedian and lateral ceratophores are characteristic. The submedian antennæ stretch back over ten segments. The tentacular cirri were lost, one was observed detached. Setæ of the body-segments comprise 6 to 8 simple capillary with two bidentate guarded acicular setæ and three acuminate aciculæ; a small bundle of fine capillary setæ passes into the dorsal cirrus, sometimes extending far along the cirrus. Dorsal cirri normal, subulate. Branchiæ commence as a simple filament on the first setiger and remain simple for 7 or 8 anterior segments, then becoming pectinate with 5 or 6 processes.

The first setiger contains the dorsal bundle of setæ for the dorsal cirrus and a ventral fascicle comprising one simple capillary seta, six characteristic tridentate compound setæ and an acicula (Plate IV., figs. 98 and 99). The second setiger resembles the first, but contains in the ventral fascicle three simple setæ and five compound setæ of the same type as in the first. The posterior lingule of these anterior parapodia is long, acuminate, cirriform.

This species is determined by the combination of characters afforded by the ceratophores, setæ, and branchiæ. It occupies an intermediate position between *O. longissima*, Gr., and *O. teres* (Ehlers). The shape of the frontal antennæ is also important; these are broad, almost foliaceous, divergent, subtriangular appendages, neither filiform, fusiform, nor subulate. Their shape is liable to vary in different states of contraction and only the combination of characters can be relied upon. The setæ give the best indications, the peculiar setæ of the anterior parapodia and the simple setæ of the body-segments.

Onuphis conchylega, Sars (1835).

Localities:—South of Manaar, 8 to 9 fathoms; and from Station LII., Cheval Paar, 3 to 6 fathoms.

It is somewhat surprising to find this species which is common at Plymouth occurring also off the coast of Ceylon. Its flattened tube, covered with large horizontally placed shell fragments, is so characteristic that it is impossible to name it differently from the type. This species should be the type of the unfortunate genus *Northia*, of Johnston. I have carefully unravelled the confusion which this genus has caused, and the result is that I agree with the Baron de St. Joseph that it should be dropped. The species has wide distribution (see Ehlers, 'Florida-Anneliden,' 1887, p. 73) and is synonymous with *Diopatra eschrichti* (Œrst.).

The shelly tube is 40 millims. long by 10 millims. wide. The tentaculum impar stretches back over 12 segments; the prostomial tentacles are smooth, the basal joints short, subequal, pauci-annulate. The tentacular cirri are slender, elongated, acuminate, much longer than the narrow buccal segment, about as long as the prostomium. Branchiæ simple, commencing on the 8th setiger; stout, acuminate, appearing flattened towards the base. Anal cirri long, slender, filiform. First three setigers porrect, the first dorsal cirrus shorter than the following; the fourth setiger slightly porrect. Ventral cirri of first and second setigers subulate; of the third, shorter, obtuse, and fleshy; of the fourth reduced to a slight projection of the first torus ventralis.

A large female measures 30 millims. long by 3·25 millims. wide; a smaller specimen is 17 millims. in body-length (excluding the antennæ), and the branchiæ are flattened. The frontal antennæ are short, ovate. In the first foot there are no setæ associated with the dorsal cirrus; the setæ of this foot comprise two acuminate aciculæ, three bidentate acicular setæ which project, and one or two bidentate quasi-compound setæ. A gill-bearing foot carries six limbate capillary setæ, two aciculæ, and two bidentate acicular setæ, the prongs of which are gaping and subequal; there are no setæ passing to the dorsal cirrus.

Onuphis dibranchiata, n. sp.—Plate IV., fig. 100.

Locality:—Galle lagoon, low-tide, 3rd August, 1902. Several fragmentary specimens.

The annulate bases of the prostomial tentacles are well developed, nearly equal, the submedian slightly exceeding the others, and the median less than the rest; the submedian peduncles are less than one-third of the total length of the appendage; the median peduncle is barely one-fourth of the total length of the tentaculum impar, and the lateral peduncles are about two-thirds the total length of the lateral antennæ. The submedian peduncles show twelve annulations in addition to the distal collar-like portion into which the flagellum is inserted.

In the above proportions it will be noted that the lateral antennæ resemble those of *Onuphis basipicta.* The frontal antennæ are short and fusiform. The subulate tentacular cirri are inserted behind the submedian antennæ and slightly exceed the length of the buccal segment. The branchiæ commence as a simple filament on the first foot and continue simple on the first 17 parapodia, becoming bifid thereafter and considerably longer than the dorsal cirri. The first dorsal cirrus is tumid at the base, rather shorter than the first gill-filament, equal in size and shape to the posterior ligule of the first foot.

The setæ of the first foot do not afford such satisfactory distinction when compared with the corresponding setæ of *O. basipicta* as might have been hoped. There is a bundle of internal setæ associated with the dorsal cirrus; then three stout aciculæ ending in narrow flexible points; next several slender quasi-compound setæ like those of *O. basipicta*, but in some of them the third tooth is absent. Besides these setæ

there are two stout setæ, tridentate (one damaged), which are not compound (Plate IV., fig. 100). These clearly represent the acicular setæ in the first foot. A parapodium from the anterior half of the body contains three aciculæ, a bundle of simple capillary setæ, two bidentate acicular setæ, and a small bundle of internal capillary setæ associated with the dorsal cirrus, passing nearly to the apex of the cirrus. The width of the worm is 3 millims.; the median antenna stretches back over 7 segments.

Onuphis holobranchiata, Marenzeller—Plate IV., fig. 101.

Station V., off Chilaw, Gulf of Manaar, 11 fathoms.

One specimen contained in a membranous tube coiled up between the valves of a Lamellibranch, adhering to one of the valves (Plate IV., fig. 101). The length of the coiled mass was 13 millims.; calcareous particles adhered to the borders of the tube; the whitish end of the tube projected beyond the posterior edge of the shell, like a siphon, to the length of 21 millims.; diameter 2·25 millims., a few shell-fragments and other calcareous débris attached. No part of the worm protruded from the mouth of the tube. After extraction of the anterior portion of the worm, which broke away from the rest of the body, it proved to be an Onuphid allied to *Onuphis holobranchiata*, Marenzeller.

The submedian ceratophores show about 10 annulations and a terminal collar; they are less than one-fifth the total length of the appendages; half as long again as the median ceratophore and equal to the lateral. The lateral ceratophores are half the total length of the appendages to which they belong. The median antenna stretches back over 21 segments, but the body has a dorsal flexure in the preserved state; the submedian antennæ are longer than the median. The frontal antennæ are obtusely subulate, coloured brown at the base. The tentacular cirri are shorter than the buccal segment, which is rather longer than the prostomium, and has a concave anterior dorsal border.

The first four parapodia are porrect, decreasing in size to the fourth, and occupying a ventral position. After the fourth, the line of parapodia bends up in a conspicuous arc to a more dorsal position. The first foot is not greatly enlarged, not longer than the buccal segment; the dorsal cirrus and posterior ligule are equal and similar and longer than the bulk of the foot. The unifilar branchiæ commence on the first foot. The first foot contains a small bundle of fine setæ passing to the dorsal cirrus, two aciculæ and four tridentate compound setæ. A parapodium from the region between the 40th and 50th segments contains, besides the internal setæ of the dorsal cirrus, four or five capillary setæ, three scalprate or comb setæ, four aciculæ, and two bidentate acicular setæ.

There are two discrepancies between the above description and that furnished by Marenzeller ('Südjapan. Ann.,' i., 1879, p. 24), and, in addition, the peculiar character of the habitaculum has not been described before. According to

Marenzeller, the buccal segment is three times as broad as long, and the tentacular cirri equal it in length. This feature may be attributed to the method of preservation. The second point relates to the lateral ceratophores which according to the author of the species are nearly twice as long as the submedian. This may be an individual variation, an abnormality, or the distinction of a local race. Unfortunately the length of the lateral ceratophore, in proportion to the total length of the antenna, is not stated. The calcareous ends of the laminæ ventrales of the jaws show an emarginate frontal border, agreeing closely with von Marenzeller's figure.

Hyalinœcia camiguina, Grube.

Grube, 'Ann. Semp.,' 1878, p. 142.

C. Crossland, "Maldive Polychæta," 'P. Zool. Soc. London,' 1904, p. 281.

Localities:—Several specimens, Station XXV., $\frac{3}{4}$ mile west-north-west of Foul Point, Trincomalee, 8 fathoms. Station XLIII., off Kalutara (Kaltura); one specimen in company with *Pectinaria* tubes. Station XLV., off Panadure; several specimens.

The tubes, 65 millims. to 70 millims., are faintly ringed at intervals of about 2 millims., and sometimes the annulation shows the double crescentic arrangement described by Grube. In the Ceylon specimens, the branchiæ commence almost constantly on the 22nd foot (23rd segment); once I found the first gill on the right side on the 21st foot. I only observed aciculæ with simple blunt rounded apices protruding from the first modified parapodium, but in the second foot may be found bidentate aciculæ and a compound seta as figured by Crossland, as well as acuminate forms. This species is closely allied to *H. tubicola*, of which it is clearly a local representative. A full account of the hyaline tube which is guarded internally by valves has been given by Mr. Arnold T. Watson ("On the habits of Onuphidæ," 'Trans. Liverpool Biol. Soc.,' vol xvii., 1903, p. 303).

Family: EUNICIDÆ.

Eunice afra, Peters (1855).

Crossland, "Polychæta of Zanzibar," 'P. Zool. Soc. London,' 1904, vol. i., p. 289.

(1.) Station V., off Chilaw, Gulf of Manaar, 11 fathoms. In this specimen branchiæ commence on the 19th foot, becoming successively 3-filar, 4-filar, and 6-filar, decreasing behind and leaving about 30 abranchiate posterior segments; they are inconspicuous, barely stretching halfway to the mid-dorsal line; body flattened and ribbon-like behind the anterior branchiferous region; length 75 millims., width 5·5 millims.

(2.) Galle, 14th February, 1902. Fragment of anterior region; gills begin as a bud on the 16th foot and rapidly attain the maximum of 5 filaments; calcareous caps of laminæ ventrales present; pale collar on the fourth setigerous segment; prostomial tentacles with violaceous annulations; body-colour of preserved specimen dark olive-green; width over the setæ, 5 millims.

Eunice antennata, Savigny.

Crossland, "Polychæta of Zanzibar," 'P. Zool. Soc. London,' 1904, vol. i., p. 312.

Locality:—South-east Cheval Paar, on pearl oysters, very numerous.

The pectinate branchiæ commence on segment VIII. (6th foot), the first gill is multifilar; they diminish towards the middle and then increase again both in size and number of filaments posteriorly. In some specimens small branchiæ commence on the 5th foot, in others on the 7th foot, very rarely on the 3rd and 4th foot. Antennæ and cirri moniliform. The acicular setæ show a third smaller tooth over the two main prongs; the compound setæ of the posterior feet are characterised by the presence of a third denticulation in a similar position to that in the acicular setæ.

Eunice coccinea, Grube.

Crossland, "Polychæta of Zanzibar," 'P. Zool. Soc. London,' 1904, vol. i., p. 297.

Station V., off Chilaw, Gulf of Manaar, 11 fathoms, two specimens.

The differentiation of this species from *E. afra* depends chiefly upon examination in the fresh condition. The colour is leucostict, but *E. leucosticta* is regarded as a synonym of *E. afra*. There is a pale collar on the 6th segment, so there is in *E. collaris*, which is another synonym of *E. afra*. Branchiæ commence on 13th foot, biramous on 15th, triramous and greatly exceeding the dorsal cirrus from 20th to 50th, long unifilar on 60th, decreasing and ceasing about the 90th, leaving upwards of 70 posterior segments without branchiæ and with rudimentary dorsal and ventral cirri. Another broken specimen had quadrifilar branchiæ. Complete specimen small, coiled, about 45 millims. long, width of anterior gill-bearing region 3 millims.; segments about 170; compound setæ normal; acicular setæ bidentate.

All characters are misleading except the shape of the body; the head is narrow, the body widening out markedly in the anterior region; the hind-body is rounded, not flattened; the intersegmental grooves are coloured brown. The general form of the body decides me to refer the present specimens to *E. coccinea*. *E. coccinea* apparently bears the same relation to *E. afra* that *E. murrayi* does to *E. antennata*.

Eunice indica, Kinberg.

Gravier, *op. cit.*, 1900, p. 242; Crossland, *op. cit.*, 'P. Zool. Soc. London,' 1904, p. 318.

Station V., off Chilaw, 11 fathoms, one small specimen, incomplete behind.

Prostomium seen from above with frontal border entire; tentacles smooth; compound setæ with projecting guards, best seen in the branchial segments; acicular setæ from the postbranchial segments with trifid tip, the apex equally bidentate, and a large subapical tooth.

Another specimen was associated in the trawl with *Phyllochætopterus ramosus* from Galle, Station XXXVIII., 17th February, 1902, depth 22 fathoms.

Eunice martensi, Grube—Plate IV., figs. 102 to 104.

Grube, "Mitth. über Euniceen," 'Schles. Ges.,' 1877; Breslau, 1878, p. 24.

Locality:—One specimen, labelled "Purple violet Eunice," taken from Buoy, Galle. The dorsum of the 6th segment is pale; segments streaked longitudinally violaceous; antennæ and cirri banded violaceous and white. Segments 178, incomplete behind; length 100 millims.; width (ventral) over the feet 8 millims., over the setæ 10 millims. Antennæ nearly smooth, quasi-articulate, cirri smooth; tentaculum impar and submedian antennæ equal to seven segments, but the former ends bluntly and has probably been longer; dorsal cirri long throughout and smooth.

Branchiæ begin as a bud on the 7th segment (5th foot), plurifilar on the 8th, in subsequent segments acquiring 14 filaments; in the 17th segment the branchial stipe is shorter than dorsal cirrus, in the 28th it is equal to the cirrus, and in the 48th longer than the cirrus (Plate IV., fig. 102). The general distribution of the branchiæ and the number of filaments will be understood from the following enumerations, the Roman numerals giving the number of the segment:—

VII.,	VIII.,	XVII.,	XXVIII.,	XLVIII.,	LX.,	LXXI.,	CXIV.,	CXL.,	CLXX.
1.	4.	13.	13.	14.	14.	14.	12.	10.	5.

In the anterior segments there are 8 or 9 dorsal capillary setæ and about 20 compound falcigerous bidentate setæ in the ventral fascicle (Plate IV., fig. 103); the two-pronged ventral acicular setæ commence at the 35th foot (Plate IV., fig. 104); comb-setæ (scalprate setæ) more numerous posteriorly, with about 12 denticulations.

Jaws:—R. II.–6; L. II.–6; L. III. (the unpaired sinistral jaw-piece)–7; R. IV.–9; L. IV.–4.

This species belongs to that section of *Eunice* characterised by multifilar branchiæ and long dorsal cirri extending from end to end of the body. The type of this section may be taken to be *E. tentaculata*, Quatrefages (1865, i., p. 317), from South Australia (Bass Strait, Tasmania). Another example is the original *E. elseyi*, Baird (1870), from Queensland (not *E. elseyi*, McIntosh), which is synonymous with *E. aequabilis*, Grube, 'Schles. Ges.,' 1877, Breslau, 1878, p. 24, from Cape York.

Eunice murrayi, McIntosh.

Crossland, "Polychæta of Zanzibar," *op. cit.*, 1904, p. 310.

(1.) Station XLV., off Panadure (Pantura), depth 25 fathoms, inhabiting a tube on the under side of a *Spondylus* valve; a polynoid was in the same tube.

Prostomium wide, frontal border deeply emarginate; antennæ moniliform; the tentaculum impar longe-articulate, stretching back over 18 segments; gills with 12 pinnæ; guards of compound setæ slightly projecting; total width in anterior region, 4 millims. The tube which accompanies the specimen is encrusted with sand and Foraminifera.

(2.) South-east Cheval Paar; occurring with *Eunice antennata*.

Branchiæ commence unifilar on segment V. (3rd foot), trifilar on VI. and VII., sexfilar on VIII., then multifilar; they decrease rapidly after the 30th foot and cease after the 43rd. Antennæ submoniliform, impar stretching over 11 segments. Setæ normal; acicular setæ trifid, as many as four in the posterior segments.

Eunice siciliensis, Grube.

Gravier, "Ann. Mer Rouge," 'Arch. Mus. Paris' (4 ser.), ii., 1900, p. 261.
Crossland, 'P. Zool. Soc. London,' 1904, p. 323. [= *Eunice valida*, Gravier.]

Station V., off Chilaw, Gulf of Manaar, 11 fathoms. Also from South-west Cheval Paar, 13th November, 1902.

Branchiæ commence on the 62nd setiger and remain simply filiform throughout. This well-known and widely distributed species can be recognised by the incurved rami of the lower jaw-plates.

Eunice tubifex, Crossland.

Station LIX., Muttuvaratu Paar, without tube.

This is a worm of large size, one specimen measuring 120 millims. by 5 millims. It is distinguished by the occurrence of spinigerous setæ in the anterior segments and falcigerous setæ in the posterior region. I have nothing essential to add to the excellent description given by Mr. Crossland ('P. Zool. Soc. Lond.,' 1904, p. 303).

The branchiæ commence as a small bud on the 20th segment and continue as a single filament, increasing in length to the 45th segment, after which a second filament appears. By the 100th segment there are still only three filaments; by the 200th there are four long filaments. Further back the number of branchial filaments increases to five, all arising from a very short axis; filaments subequal, much longer than dorsal cirrus; the latter increases somewhat posteriorly.

Some statements in a footnote on p. 308 of Mr. Crossland's paper require to be modified. Schmarda's account of *Eunice depressa* from Auckland, New Zealand, which also possesses the two kinds of compound setæ, is fuller than many of his descriptions; this worm is, however, a *Marphysa*, since, as shown and stated by Schmarda, tentacular cirri are absent. Grube named two species of *Eunice* with spinigerous setæ from the Philippines, namely, *E. impexa* and *E. megalodus*, but records no distinction between the anterior and posterior setæ.

There is a headless fragment over 150 millims. long accompanying the specimen above described.

Marphysa chevalensis, n. sp.

Locality:—South-east Cheval Paar, Gulf of Manaar.

This species belongs to the same group as *Marphysa depressa* (Schmarda, 'Neue Wirbellose Thiere,' ii., 1861, p. 127, New Zealand) and *M. fallax*, Marion et Bobretzky

('Ann. Marseilles,' 1875, p. 13). Its interest lies in its occurrence here, not in its supposed differences from its two allied forms, since there are no differences which are figurable. The character of the group depends upon the presence of two kinds of compound setæ, spinigerous and falcigerous, in the parapodia. The special feature of the Ceylon representative depends upon the distribution of the branchiæ. Length 25 millims., width 2·75 millims.; 104 setigerous segments.

The frontal border of the prostomium is emarginate and the division is continued as a shallow median groove along the dorsal surface of the head. Branchiæ commence as a small filiform process on the 11th foot, uniramous from 11th to 19th foot, biramous from 20th to 25th, triramous from 26th to 68th, decreasing and ceasing at the 85th foot. Dorsal cirri fusiform, decreasing in size posteriorly. Anal cirri subulate, smooth, with ring of brown pigment at base; ventral anal styles minute filiform. Compound setæ, falcigerous and spinigerous, the spiniform appendices longer and shorter; both kinds of setæ occur together from the first parapodium, but in the specimen now being described only the spinigerous form was observed in the posterior segments.

In the anterior parapodia a dorsal fascicle of limbate capillary setæ, a central group of three aciculæ and the ventral fascicle of compound dimorphic setæ; in the posterior parapodia the dorsal fascicle contains limbate and scalprate setæ; there is a central group of two aciculæ, a ventral fascicle of compound setæ and a ventral bidentate acicular seta. A second specimen, darker coloured, anal cirri black, showed both kinds of setæ in the posterior feet; branchiæ from 10th to 55th foot; maximum number of three filaments observed on one foot only; length 9 millims.; width nearly 2 millims; segments about 73.

Paramarphysa orientalis, n. sp.—Plate IV., fig. 105.

Locality:—South-east Cheval Paar, Gulf of Manaar. Several specimens.

Length 21 millims., width 1 millim.; 91 setigerous segments.

Prostomium almost entire, a shallow groove only dividing the front; antennæ short, about the length of the prostomium, tentaculum impar somewhat longer. There is an eye-spot on each side of the head between the bases of the submedian and lateral antennæ. Bidentate ventral acicular setæ begin on the 26th foot; a segment or two behind this the main aciculæ become dark coloured; there may be two acicular setæ in the posterior parapodia. The superior fascicle of capillary setæ shows slight difference in anterior and posterior regions, the limbate tract being shorter and more convex behind; comb-setæ with long marginal laciniæ occur as far forwards as the 9th foot. The compound bidentate falcigerous setæ are normal, not markedly different in front and behind, distinguished by the slight inflated appearance of the end of the shaft (Plate IV., fig. 105).

Only one other species of *Paramarphysa* has been described to my knowledge, namely, *P. longula*, Ehlers ('Florida Ann.,' 1887, p. 99).

Lysidice collaris, Ehrenberg and Grube.

Grube, 'Ann. Semp.,' 1878, p. 166; Gravier, 'Arch. Mus. Paris' (4 ser.), ii., 1900, p. 272. Crossland, 'P. Zool. Soc., London,' 1904, p. 284.

Station V., off Chilaw, Gulf of Manaar, 11 fathoms. One specimen; length about 15 millims. Several other specimens in the collection.

Nematonereis unicornis, Schmarda.

Schmarda, 'Neue Wirbellose Thiere,' ii., 1861, p. 119. (Atlantic Ocean.)

Locality:—South-west Cheval Paar, Gulf of Manaar. Two specimens.

In the smaller specimen the head is entire and rounded; in the larger slightly emarginate; a pair of large eyes at the back of the head and between them a small occipital tentaculum impar about the same length as the prostomium. There are no tentacular cirri; no branchiæ; two achætous buccal segments. The larger specimen is a mature female.

In the parapodia the dorsal cirrus is short, subulate, about as long as the pharetra setarum; a central acicula separates the setæ into superior and inferior groups, the former consisting of simple capillary setæ, the latter of compound, bidentate, falcigerous setæ. In the posterior bundles there is also a guarded bidentate acicular seta, the subterminal tooth much larger than the apical tooth. The jaws are pale and normal:—II. 5-4, III. 4.

Family: LUMBRICONEREIDÆ.

Aglaurides fulgida (Sav.)—Plates IV. and V., figs. 106 and 107.

Gulf of Manaar. Several specimens.

The largest measured as much as 7 inches in length, a few segments missing behind; dorsum very convex; width 5 millims.; width including setæ nearly 9 millims.; segments narrow and very numerous; dorsal cirri large, foliaceous; head rounded to triangular in shape.

The characterisation of the cirrobranchiate Eunicea is at present somewhat obscure, and it is not rendered less so by the fact that the present species agrees identically with Schmarda's *Œnone diphyllidia* from Jamaica in respect of the size and shape of the dorsal cirri, the buccal and the parapodial armatures.* (Plate V., fig. 107.)

The buccal segment is of double nature, as in *Lumbriconereis*, the intersegmental groove being plainly visible at the sides and continued forwards to the edge of the mouth, so that the processus oralis of the second segment borders the mouth below. Dorsally the buccal segment lies over the back of the prostomium like a collar, the groove between the collar and the head deepening into a profound sinus, in which three minute papilliform occipital tentacles are occluded. In front of the tentacles there are four eyes, two large lateral eyes and two small submedian eyes, the latter

* *Cf.* Ehlers, 'Florida-Anneliden,' 1887, p. 109, Taf. 34.

sometimes simple, sometimes multiple (Plate IV., fig. 106). The arrangement of the eyes is the same as in *Œnone diphyllidia*, and they can easily be found by raising the margin of the collar. The presence of the antennæ or occipital tentacles is the one feature in which *Aglaurides* is believed to differ from *Œnone*, and in view of the absolute identity of the other parts this divergence appears remarkable.

In *Aglaurides*, especially if the material be well preserved, the mere pulling back of the collar will not always suffice to discover the prostomial tentacles. I have found it necessary to divide the collar by a longitudinal incision before the antennæ come into view. They are extremely fugitive structures, not too easily found even in half-macerated examples, so deep do they lie within the recesses of the nuchal sac. In *Aglaurides erythrœensis* recently described by Gravier ['Arch. Mus. Paris' (4th ser.), t. ii., 1900, p. 278] from the Red Sea the character of the jaw-pieces seems to differ from that of the corresponding parts in *A. fulgida*. The reader is left with the impression, that while "les pièces correspondantes sont plus développées à droite qu'à gauche," yet on the whole they are subequal, and only one half is figured on the plate. Otherwise the species is indistinguishable from *Aglaurides fulgida*, the shape of the head varying as mentioned above. The author does not mention the radices maxillarum, which in *A. fulgida* are very long, longer than the rest of the upper jaw, as in *Maclovia* and *Halla*, not short as they are in *Lumbriconereis* and *Lysarete*.

In addition to the characters presented by the antennæ and the details of the jaws as described and figured by Ehlers ('Borstenwürmer,' 1868, p. 408) the genus *Halla* (= *Cirrobranchia*, Ehlers) differs from *Aglaurides* in having two entire apodous segments behind the head, a peculiar processus oralis being furnished by the first segment. *A. fulgida* has been recorded from Ceylon by Michaelsen, 'Jahrb. Hamburg. Wiss. Anst.,' ix., 2, p. 99).

Aracoda obscura, n. sp.—Plate V., figs. 108 to 112.

Station XLIII., off Kaltura. A single specimen, incomplete behind, 16 millims. long, 1 millim. wide, in an empty *Pectinaria* tube.

Colour nearly black, with strongly iridescent tough cuticle. Prostomium pear-shaped or conical, nearly equal to the four next segments (Plate V., fig. 111); two distinct achætous segments in front, without processus oralis of the second segment. The usual long posterior ligule on the parapodia. There are six or seven simple curved limbate setæ in the parapodium; in some the limbus is nearly plain, in others denticulate as shown in Plate V., fig. 112. The dilated portion of the setæ is finely and obliquely striated.

The only way to identify the species of this and allied genera of *Lumbriconereidæ* is by the character of the jaws. These are black and overlap, consequently they are difficult to see in themselves and not easy to prepare from such a small specimen. The principal feature in this case is provided by the jaw-pieces of the first pair which

are subequal and without a special terminal hamulus distinct from the dentate portion (Plate V., fig. 108). The jaw-pieces of the second pair are the most difficult to make out satisfactorily; one side, so far as I could ascertain, showed three large teeth, and a long edentulous shaft reaching back to the radices maxillarum (Plate V., fig. 110); on the other (probably the left) side the second jaw-piece, which was fractured near the apex, showed a strong apical tooth and a long posterior dentate portion (Plate V., fig. 109). There are, as usual, five pairs in all, the fifth being a simple hamulus. As stated above, the diagnostic character is the absence of a pronounced diastema between the apical tooth and the succeeding teeth of the first pair of jaws.

FAMILY: GLYCERIDÆ.

Glycera lancadivæ, SCHMARDA—Plate V., figs. 113 to 116.

SCHMARDA, *op. cit.*, 1861, p. 95; MICHAELSEN, 'Jahrb. Hamburg. Wiss. Anst.,' ix., p. 102.

Locality:—Galle, 14th February, 1902. Two specimens.

This species is a representative in these waters of the Atlantic *Glycera capitata*, and is characterised by the absence of branchiæ and by the biligulate anterior lip of the parapodium, the posterior lip being rounded and slightly emarginate. It appears to present a dimorphism analogous to that existing between *G. capitata* and the variety *G. setosa*. In the typical form the parapodia are longer than in the second form; we may refer to these as A and B respectively. In both, the body segments are biannulate, and there are two kinds of compound setæ differing in the structure of the articular end of the shaft; in one kind the transparent guard projects beyond the edges of the cup, in the other the guard is level with the cup and shows fine sulcations (Plate V., figs. 113 and 114). In form A, the ligules are fusiform and approximately equal in bulk, the ventral ligule rather longer (Plate V., fig. 115). In form B, the ligules are obtuse and the ventral ligule, besides being longer, has about twice the bulk of the dorsal ligule (Plate V., fig. 116). If these specimens had been taken at different times and places they would probably have been described as separate species. The extruded proboscis (form B) is covered with minute papillæ arranged irregularly, and of two kinds, acuminate and rounded, the former greatly predominating. Length of specimen of form A (incomplete behind), upwards of 60 millims.; form B, complete with subulate anal cirri, 45 millims. long, including the proboscis (7 millims.).

FAMILY: SPIONIDÆ. [See also p. 325.]

Polydora hornelli, n. sp.—Plate V., fig. 117.

From pearl oysters, Gulf of Manaar.

It is hard to say whether this species is really distinct from *Polydora ciliata*; the differences, so far as can be judged from preserved material and published records, are very slight, but such as they are, they seem to afford ground for separation when taken in conjunction with the geographical distribution and the character of the host.

The general appearance of the anterior end resembles that figured by CARAZZI* for *P. ciliata*. The ground colour is chocolate brown, and this pigment occurs upon the peristomium and upon the greater part of the caruncle; the latter projects beyond the front of the peristomium, terminating in two rounded lobes, divided from one another by a shallow notch. The proportions of the caruncle are characteristic; it is inserted over the length of the peristomium and over the first two segments of the trunk; in the region of the first setigerous segment there is a slightly dilated pale area causing an interruption of the brown pigment; there is a patch of pigment in the centre of this area which I shall call the ocular area, although I could not distinguish definite eye-spots; on each side of the ocular area on the dorsum of the first setigerous segment, midway between the caruncle and the margin of the body, there is a very small cirrus; at the outer margin of the same segment, on each side, there is another cirriform appendage, below which occurs a capillary fascicle; the latter appendage is shown in CARAZZI's figure, but not the former; the portion of the caruncle in front of the ocular area is longer than the portion behind it. The remaining segments of the body carry notopodial and neuropodial setæ, the 2nd, 3rd, 4th and 6th segments with capillary setæ only. The notopodial setæ of the 5th setigerous segment are modified, consisting of an oblique row of eight large brown acicular setæ with two not fully formed in reserve, each acicular seta being accompanied by a delicate colourless spatulate seta. The acicular setæ of the 5th segment differ from those figured by CARAZZI for *P. ciliata;* in *P. hornelli* these setæ are not toothed, but a convex limbus or vane occurs below the curved apex (Plate V., fig. 117). [See Mr. ARNOLD WATSON'S "NOTE" on p. 325—W. A. H.]

From the 7th segment the neuropodial series of capillary setæ are replaced by a single row of about a dozen bidentate guarded acicular setæ not differing in structure from those of *P. ciliata* as figured by Professor McINTOSH in 1868.† The branchiæ also commence on the 7th setigerous segment, but the material is so fragmentary that I cannot say where they end. The diameter of a large specimen is 1·5 millims. No other dorsal setæ beyond the modified setæ and their spatulate attendants were observed in the 5th segment, but a bundle of very delicate neuropodial setæ occurs at their base. The 5th segment is firm and the fore-body porrect. The 2nd, 3rd, 4th, and 6th setigerous segments carry a short cirriform notopodial ligule behind the dorsal fascicle. The long peristomial tentacles are lost from most of the specimens.

FAMILY: CAPITELLIDÆ.

Notomastus zeylanicus, n. sp.—Plate V., figs. 118 and 119.

Locality:—East Cheval Paar, 8 fathoms.

Anterior fragment of small individual. The first two segments are achætous; the

* D. CARAZZI, "Revisione del genere *Polydora*, BOSC, e cenni su due specie che vivone sulle ostriche," 'Mitth. Zool. Stat. Neapel,' xi., 1893, see Taf. ii., fig. 4.

† See also T. WHITELEGGE, "Report on the Worm Disease affecting the Oysters on the Coast of New South Wales," 'Rec. Austral. Mus. Sydney,' 1890, vol. i., No. 2.

eleven following segments are biannulate and carry dorsal and ventral fascicles of capillary setæ. The unciniform setæ commence on the 14th segment, the dorsal torus containing a single row of 19 setæ, the ventral torus a single row of 34 (Plate V., fig. 119). From the mouth projects a median tongue-like lobe. The head is half withdrawn into the buccal segment, but by pressing the latter backwards an acervus of eye-spots at the side of the head can be seen (Plate V., fig. 118).

Family: OPHELIIDÆ.

Armandia lanceolata, n. sp.—Plate V., fig. 120.

Locality:—South of Manaar Island, 8 to 9 fathoms.

One specimen about 17 millims. in length; 29 pairs of parapodia, the last three or four of which are very small; 22 pairs of cirriform branchiæ commencing on the 2nd setigerous segment; eleven pairs of lateral eyes situated in front of the parapodia from segments VII. to XVII. inclusive; no cephalic eyes observed. This is a slender worm 1 millim. in diameter; body pale.

Ophelioids of this group show a striking resemblance to *Amphioxus* in shape, size, habits, distribution, consistency, translucency, and movements. This has been remarked previously by Lo Bianco (1893) in the case of *Armandia polyophthalma* and by me (1896) in New Guinea waters.* Although infinitely removed from each other in morphology, *Armandia* and *Amphioxus* are closely approximated in bionomics. It is a case of true homoplasy; there is no question of affinity, nor of mimicry, nor of parallel evolution.

The ventral musculature in this species is so arranged as to cause two prominent longitudinal ventro-lateral ridges, like metapleural folds, extending uninterruptedly from the mouth to the base of the anal siphon, leaving a narrow deeply depressed median ventral tract, the neural groove, between them; and a lateral groove above on each side of the body in which the parapodia lie. The branchiæ can be kept lengthwise lodged within the lateral groove. The anal siphon is a narrow membranous tube terminating in a circular orifice fringed by not less than 12 subulate papillæ, subequal.

In *Armandia leptocirrus*, Grube ('Ann. Semp.,' p. 194) there are 33 pairs of gills,† a pair to each of 34 segments excepting the first; the lateral eyes are said to commence on the fifth setigerous segment and to occur on the ten following segments. Sometimes the eyes may be absent or lost from some of the ommatophorous segments. In this specimen of *A. lanceolata* they are complete on the right side, but on the left side missing from the 11th to 13th segments. The first eye occurs on the 7th setigerous (6th branchiferous) segment, the last on the 17th setigerous (16th branchiferous) segment. The anal siphon has a marked ventral flexure in the

* Cav. Lo Bianco, 'Atti Acc. Napoli,' v., 1893; A. Willey, 'Quart. Journ. Micro. Sc.,' vol. 39, August, 1896, p. 219.

† Given as 22 pairs by a misprint.

preserved specimen. The simple capillary setæ issue in two bundles, a dorsal bundle of five long setæ and a ventral bundle of about eight shorter setæ.

The anterior end of the body is produced as a transparent rostrum which terminates in a white appendix (Plate V., fig. 120). The mouth lies below on the level of the base of the rostrum, and the paired nuchal organs occur behind at a distance from the mouth, equal to the latter's distance from the frontal extremity. The long simple gills are traversed by blood-vessels.

Armandia leptocirris, GRUBE. ('Ann. Semp.,' 1878, p. 194.)

Locality:—Cheval Paar, Gulf of Manaar.

This species is twice as bulky as *A. lanceolata*. The essential differences are not easy to specify by the examination of preserved material only. Length 21·5 millims., diameter 2 millims.; 37 setigerous segments; 27 gills, commencing at the second setigerous segment; 20 marginal anal papillæ, larger and smaller intermixed; 14 lateral eyes, commencing in front of the 6th gill. Nuchal organs lie in front of the mouth; metapleural ridges commence at the sides of the mouth. The most striking feature of the specimen here described is the occurrence of several small cirriform papillæ protruding from the buccal orifice. Notopodia and neuropodia minute, contiguous.

Another example from Modragam Paar does not show the buccal papillæ protruding.

Polyophthalmus australis, GRUBE—Plate V., fig. 121.

Two specimens from east side of Cheval Paar, one measuring 15 millims. long by 1 millim. wide; the other 8 millims. by 0·5 millim.

The setæ are extremely delicate and not obvious at first examination. The head is rounded, the body with characteristic pigment markings figured by GRUBE ('Ann. Semp.,' p. 196), and the anus is surrounded by a circlet of papillæ. The body has the consistency of that of an *Ophelia*. When placed in fluid of different density from that in which it had been kept, it twitched convulsively like a Nematode.

In the smaller specimen there are 26 setigerous segments, capillary setæ in separate dorsal and ventral fascicles, the latter issuing from a convex crateriform elevation. The ciliated apparatus of the head, not figured by GRUBE, is shown on Plate V., fig. 121. The lateral eyes were not distinct.

FAMILY: FLABELLIGERIDÆ.

Stylarioides parmatus, GRUBE—Plate VIII., fig. 5.

Stylarioides parmatus, GRUBE, 'Ann. Semp.,' 1878, p. 199.
Stylarioides iris, MICHAELSEN, 'Jahrb. Hamburg. Wiss. Anst.,' ix., p. 108.

Muttuvaratu Paar. Four specimens, one very small.

The distinction between *S. iris* and *S. parmatus* is based upon the number of long

and gorgeously iridescent setæ of the second segment. These are disposed round the head in four bundles ; each bundle may contain up to 10 setæ. GRUBE found only six setæ in each bundle. The setæ of the third segment are much more slender and shorter than those of the second, but equally numerous, though the number of setæ in both these segments varies, probably in many cases through accidental loss. The caudal extremity of the body may be recurved as in *Pallasia*, as noted by Mr. WATSON, but, unlike *Pallasia*, the segments are all setigerous (Plate VIII., fig. 5).

FAMILY: MALDANIDÆ.

This family may be divided into three sub-families :—Clymeninæ, Rhodininæ, and Nicomachinæ. For the identification of the worms belonging here it is essential that the whole body should be preserved. There is a fragment of a Nicomachine Maldanid, of which only the six anterior setigerous segments have been preserved, obtained in 14 fathoms to the west of the northern end of the Periya Paar at Station LXI. In the absence of the anal segment it is unfortunately impossible to assign it to its proper genus with any certainty.

Nicomache truncata, n. sp.—Plate V., figs. 122 and 123.

Its head is extremely characteristic, the front vertical with a median crest widening out below into a transverse ridge which overhangs the mouth (Plate V., fig. 123). The peristome is indistinguishably fused with the prostomium, and the two together compose a remarkably short head. This is followed by a short first setigerous segment with the capillary fascicle in the centre ; next a slightly longer segment with the capillary fascicle nearer to the anterior than to the posterior border ; thereafter the segments become elongated, the setæ and tori occupying an anterior position in each segment. Below the first and third capillary fascicles there is a large acicular seta ; below the second there are three acicular setæ on the left side, one only on the right (Plate V., fig. 122).

FAMILY: AMMOCHARIDÆ.

Ammochares orientalis, GRUBE—Plate V., figs. 124 and 125.

GRUBE, 'Ann. Semp.,' 1878, p. 204.

Station LIV., south of Adam's Bridge, 4 to 40 fathoms. One specimen.

Total length 28 millims., width 1·5 millims., tapering to less than half this size behind. Length of the laciniate gills, 2 millims. ; length of first segment 2·5 millims., of second 3 millims., third 3·75 millims., fourth 3·25 millims., fifth 2·5 millims. Total number of setigers 22 pairs ; the last eight segments are quite short and were detached from the rest of the body. The first uncinigerous torus occurs below the fourth capillary fascicle. The œsophageal nerve-collar becomes confluent with the ventral nerve-cord in the region between the first and second fascicles (Plate V., fig. 124).

The first segment is a composite one, comprising three pairs of capillary fascicles

unaccompanied by uncinigerous tori; of these the third pair has not been noticed by Grube (Plate V., fig. 125). On the dorsal side in the middle line, slightly in advance of the first pair of fascicles, there is a peculiar nuchal organ flush with the surface of the body (Plate V., fig. 125). The uncini are arranged in a polystichous manner in the tori; as many as 20 rows of peculiar minute uncini of a type best defined as ammocharine; when examined *in situ* they look like the separated teeth of multidentate uncini. The capillary setæ are linear, non-limbate, finely squamose towards the acute apex.

Tube tough, mucoid, encrusted with sand grains which are arranged with considerable regularity in an imbricating manner. Wider in front, tapering behind, the tube is much longer than the contained worm, being about 60 millims. The lips of the anterior and posterior orifices are approximated at their respective ends, so that the openings of the tube appear closed. The specimen was taken in company with *Panthalis nigromaculata*. The structure and habits of the Ammocharidæ form the subject of a paper by Mr. Arnold T. Watson in 'Journ. Linn. Soc.,' Zoology, vol. xxviii., 1901, pp. 230–260, plates 23–25.

Family: CHÆTOPTERIDÆ.

Chætopterus appendiculatus, Grube—Plate V., fig. 126.

Grube, "Ann. Ceylon" (Holdsworth coll.), 'P. Zool. Soc. London,' 1874, p. 328.
Herdman, 'Ceylon Pearl Oyster Report,' Part I., 1903, p. 80.

Locality:—Station LXII., near Periya Paar, 7 to 13 fathoms.

There are ten thoracic segments, the last two carrying uncinigerous tori and the last bearing a large aliform notopodium. The penultimate thoracic tori are separated by a deep median ventral notch; the last thoracic tori are confluent across the middle line. Uncini of the last thoracic torus mostly 6-dentate, some 5-dentate; uncini of a ventral abdominal torus 8-dentate.

In Grube's original description, which was based upon a large specimen 124 millims. long, the tube measuring 364 millims. by 22 millims. in diameter, the uncini of the posterior ventral tori are said to have nearly 20 teeth. This is a large number for *Chætopterus*, twice the normal number,* and might conceivably be due to the uncini lying appressed, end to end, as they frequently do.

Of the thoracic parapodia the first, fourth, and ninth are the shortest in the specimen under examination. The fourth contains seven broad modified setæ of the type characteristic of the family. In this case these setæ show a finely crenulate or beaded distal border (Plate V., fig. 126). The fore-body of the specimen measures 5·25 millims. long by 3·5 millims. broad, hence much smaller than Marenzeller's *Ch. cautus* from Japan, where the corresponding measurements were 20 millims. by 10 millims., and there were 20 to 30 chætopterine setæ in the fourth parapodium.

* *Cf.* Crossland, "Maldive Polychæta," 'P. Zool. Soc. London,' 1904, vol. i., p. 276.

The tube is pergamentaceous, finely fibrous, thinly encrusted with mud and calcareous minutiæ. The posterior notopodia adhered firmly to the inner wall of the tube and were greatly elongated.

Phyllochætopterus herdmani (Hornell)—Plate V., figs. 127 to 132.

Spiochætopterus herdmani, Hornell, 'Ceylon Pearl Oyster Report,' Part I., 1903, p. 16.

Locality :—Galle shore, under stones.

Narrow cylindrical tubes encrusted with relatively coarse sand-grains and hard fragments of all kinds, including Foraminifera. The worms outside their tubes are soft and convoluted, and the hinder portion of the body is very fragile. The three regions of the body behind the buccal region are the thoracic region, with ten (in one case nine) setigerous segments; the branchial region, consisting of two segments; finally the abdominal region with as many as 40 to 50 segments. The ventral wall of the thoracic segments is thickened to form a large glandular cushion, and the lateral wall of each abdominal segment is marked by a long narrow brown tract between the dorsal and ventral divisions of the parapodium on each side; sometimes this pigment tract is very dark. Above its dorsal end occurs the clavate notopodium, and below its ventral end the neuropodium, subdivided into two narrow uncinigerous lobes. The head is surrounded by an incomplete collar, open dorsally (Plate V., fig. 127); above and behind the dorsal ends of the collar occurs the second pair of tentacles, supported by a bundle of three long delicate internal setæ. The long spirally coiled tentacles of the first pair are inserted immediately in front of the second pair, and are still retained in some of the specimens.

The first parapodium contains about twenty spatulate or vane-tipped setæ, arranged in general in a single row, forming a dorsiventral monostich. The length and width of the vane varies; sometimes it terminates in a point, generally its border is broken up into shreds (Plate V., fig. 131). The second parapodium resembles the first, and so does the third as a rule, but in one specimen there are five modified setæ (resembling those which usually occur only in the fourth parapodium) intercalated between the normal spatulate setæ (Plate V., fig. 129). The fourth parapodium contains, in addition to the spatulate setæ, eight or nine modified flattened setæ (Plate V., fig. 128). The remaining thoracic parapodia contain the usual setæ. A notopodium from the second branchial segment contains 16 or 17 long internal setæ in the inner division of it. The plan of a branchial segment is shown on Plate V., fig. 130. The borders of the notopodium below the distal expanded bifid portion are densely ciliated. The dorsal body-wall of the branchial region appears to be glandular.

Next to the notopodium comes a gill, a thin membranous expansion folded upon itself in the preserved specimen; this passes below into a wing-like dermal fold with free surfaces and a thickened outer border, which is the uncinigerous torus. The uncini in a neuropodium of a branchial segment have 9 to 11 denticulations; when

9 or 10 occur they are distinct, when 11 are present the apical tooth is very small. The abdominal notopodia carry a bundle of four spatulate setæ. The abdominal uncini show 10 or 11, perhaps sometimes 12 denticulations. All the uncini show the peculiar ribbed structure noted by previous authors in other species (Plate V., fig. 132).

This species is closely related to *Phyllochætopterus aciculigerus*, described by CROSSLAND from the Maldive Group ('P. Zool. Soc. Lond.,' 1904, p. 278). The aspect of the anterior region varies greatly according to the state of the preserved material; when well protracted and hardened, it resembles the condition figured by CROSSLAND for *P. elioti* from Zanzibar (*cf.* Plate V., fig. 127), except for the absence of eyes in *P. herdmani.*

In nine specimens there are ten pairs of thoracic parapodia, in one specimen nine pairs, the latter being the number given for *P. aciculigerus.* The principal substantial difference appears to be due to the presence in the last-named species of a glandular cirrus of uncertain homologies arising from the centre of the neuropodial tori of the first branchial segment.

Phyllochætopterus ramosus, n. sp.—Plate V., figs. 133 to 136.

Locality:—A thick cluster of slender brown translucent ramifying tubes (Plate V., fig. 133), overgrown and welded together by foreign incrustations of other tubicolous and colonial organisms and vegetable growths, trawled off Galle, at Station XXXVIII.

A fairly complete worm measures 25 millims. in length, its tube twice this length, and 1·5 millims. in diameter. The first region of the body consists of 15 segments; the fourth parapodium contains one, sometimes two broad flattened modified setæ (Plate V., figs. 134 and 135). The second or branchial region comprises about 16 segments. As the worms were all preserved inside their closely investing tubes, the branchial region is not preserved sufficiently well to show details clearly. Practically it may be distinguished from the third or abdominal region by its long styliform notopodia, each supported by not more than four internal slender setæ. The abdominal notopodia are clavate papillæ, each supported by a single seta. The long tentacles are coloured with brown patches which give them a banded appearance; they are followed by the small second pair of tentacles. The prostomium carries a pair of elongated eye-spots.

This species represents *P. pictus*, CROSSLAND ('P. Zool. Soc., London,' 1903, p. 174), from which it differs in the character of the modified setæ of the fourth parapodia, the number of branchial segments and the character of the tubes. In the anterior branchial region the uncinigerous tori encircle the sides of the body, appearing like silver bands by reflected light. The uncini are excessively numerous in these bands, and are disposed in a polystichous manner, nine or ten closely packed rows. Each uncinus shows about twenty minute teeth, the lower end terminating in a blunt, curved process (Plate V., fig. 136).

Family: CIRRATULIDÆ.

Cirratulus cylindricus, Schmarda—Plate VI., figs. 139 and 140.

Schmarda, 1861, 'Neue Wirbellose Thiere,' ii., p. 59.

Localities :—Galle, East Cheval Paar, &c. Associated with *Eupomatus heteroceros*, *Eunice antennata*, &c.

The paired dorsal acervi of tentacular cirri occur on the fifth setigerous segment, a double row on each side separated by an interval across the middle line. The body is short and thick, simply flexed, not twisted, and equal at both ends; length 16 millims., diameter upwards of 3 millims.; setigerous segments 130. The head is round and short, crescent-shaped, the mouth gaping below. Capillary setæ commence on the fourth segment, the ventral acicular setæ appear on the 19th setigerous segment, the dorsal acicular setæ on the 23rd; the capillary setæ are continued to the end of the body.

In *C. dasylophius*, Marenz., the tentacular acervi occur on the dorsum of the third and fourth setigerous segments; the ventral aciculæ begin on the 29th, the dorsal on the 43rd. In *C. comosus*, Marenz., the tentacular acervi occur on the seventh setigerous segment; the ventral aciculæ begin on the 42nd, the dorsal on the 85th. Both these species are from South Japan. The acicular setæ afford no diagnostic character in themselves.

Another, and perhaps more typical, individual of 30 millims. (from Galle, 4th August, 1902), which I assign to this species, shows the same form of head, but the dorsum of the anterior segments is elevated, and the tentacular acervi extend over more than one segment (Plate VI., fig. 139). The gill-filaments are inserted high up on the body, remote from the dorsal fascicles; the ventral acicular setæ commence on the 11th setiger, the dorsal about the 26th. The frontal border shows pigment specks (Plate VI., fig. 140).

In another specimen of 35 millims. from East Cheval Paar, 8th November, 1902, 8 fathoms, the ventral acicular setæ commence on the 9th setigerous segment, as many as six in one fascicle in the anterior segments, becoming less numerous and stouter behind; the dorsal acicular setæ are more slender than the ventral, and commence on the 25th setigerous segment. The first lateral branchial filament appears on the first setigerous segment, the transverse acervi occur in the region of the 7th and 8th body-segments (*i.e.*, 4th and 5th setigerous segments). Behind the acervus the segments carry one pair of branchiæ inserted at slightly different levels, lateral and more dorsal.

Cirratulus complanatus, n. sp.

Station XLV., off Panadure, 25 fathoms. Three specimens.

The length of the ribbon-shaped body is 33 millims., greatest width 5 millims. The body is much flattened, giving a flattened rectangle in section; the head pointed,

elongate conical. The tentacular acervi occur on the dorsum of the second setigerous segment, *i.e.*, the fifth body-segment, the first three segments being as usual achætous. In one specimen a small gill occurs on the third achætous segment. Both dorsal and ventral acicular setæ are present in the 36th setigerous segment. Gill-filaments only occur in the anterior region of two complete individuals. The gill-filaments and tentacular filaments give the appearance of a dense tangle in front, the rest of the body being bare.

The species differs from *C. dasylophius*, MARENZELLER, in the position of the tentacular cirri, the distribution of the gill-filaments and the shape of the body.

Heterocirrus typhlops, n. sp.—Plate V., fig. 138.

Locality :—South-west Cheval Paar, Gulf of Manaar.

A very small worm, total length 10·5 millims., diameter less than half a millimetre. Capillary non-limbate setæ in both fascicles; dorsal and ventral acicular setæ commence at the first setigerous segment; they resemble those of *Cirratulus;* the ventral acicular setæ are two in number, more curved and thicker than the dorsal. The disposition of such cirriform appendages as remain is shown on Plate V., fig. 138.

FAMILY: AMPHICTENIDÆ.

Pectinaria panava, n. sp.—Plate V., fig. 137.

Locality :—Ceylon Seas.

The specific name is the vernacular word for comb, referring to the comb of paleæ. Nuchal disc subcircular, carrying a transverse series of twenty paleæ, divided by an interval into two linear groups of ten each; the paleæ terminate in curved setiform apical processes. At each ventro-lateral angle of the disc, at the outer ends of the paleal series, there is a tentacular cirrus; a similar pair of cirri occurs on the second segment. In front of and below the paleal crown there is a wide semilunar membrane carrying not less than 32 laciniæ frontales. Below the frontal membrane are the grooved tentacles surrounding the mouth. Third and fourth segments branchiferous; ventral portions of 3rd, 4th, 5th and 6th segments elevated, the crests traversed by transverse muscles; the crest of the 4th segment is produced on each side as a blunt lateral lobe below the gill; on the posterior surface of the lobe there is a pinhole aperture. Seventeen capillary fascicles commencing from the 5th segment; uncinigerous tori from the 8th; uncini with about eight teeth, reduced towards the base (Plate V., fig. 137). Scapha acetabuliform, with terminal supra-anal semilunar valve and two rows of dorsal paleæ at the base, 7 paleæ on each side.

This species is chiefly characterised by the number of paleæ, which however is likely to vary, and by the large number of the laciniæ frontales, which are filiform processes along the edge of the frontal membrane.

Family: SABELLARIIDÆ.

Pallasia pennata (Peters)—Plate VIII., figs. 1 and 2.

Sabellaria pennata, Peters, "Ueber die Gattung *Bdella* Sav. und die in Mossambique beobachteten Anneliden," 'Arch. f. Naturg.,' xxi., 1855, p. 42; also 'Monatsber. Berlin. Akad.,' 1854, p. 613 (quoted from Grube, 'Ann. Semp.,' 1878, p. 220).
Hermella bicornis, Schmarda, 1861, 'Neue Wirbellose Thiere,' p. 24.

Locality:—This worm occurs off the west coast of Ceylon either singly or in large colonies, and builds a tube of coarse sand-grains cemented together, so as to form a sandstone of excessive hardness which is capable of withstanding the full force of the waves during the South-west Monsoon. It is evidently an important factor in the preservation of the coast line. Sometimes the tubes are still further protected by a Nullipore covering. The internal diameter of a large tube is about 6 millims.

The specific name given by Schmarda refers to the presence of a pair of large brown hooks bent towards the middle line, placed at the dorsal ends of the peristomial lobes which, with their armature, constitute the paleal crown. There is usually only one pair of hooks, but I have seen a specimen with three hooks (two on one side), and Peters describes four hooks (two pairs) in the single specimen examined by him. Each peristomial lobe terminates anteriorly in a truncate dorso-ventral crescent-shaped area, from the inner and outer arcuate borders of which the modified bristles or paleæ arise. The number of paleæ in the inner row varies roughly between 20 and 30; the number in the outer row between 30 and 45. The paleæ of the outer row are long curved spines, slightly widened and strongly serrated along the distal three-fifths of their length; towards the apex of the palea the serrations are larger on the concave border than on the opposite border; all are directed towards the apex of the palea. The paleæ of the inner row are acuminate, smooth, and more slender than those of the outer row. In side view a series of 8 to 12 subulate papillæ occurs below the outer row of paleæ, the most dorsal papilla being placed behind the hook on each side, as shown in Mr. Watson's drawing (Plate VIII., fig. 1).

Dorsally the peristomial lobes are confluent across the middle line up to the level of the hooks; ventrally they are separated down to the level of the mouth. The inner surface of each peristomial lobe is beset with numerous tentacular cirri arranged in rows, the columns being indicated externally by crenulations of the ventral border of the lobe (Plate VIII., fig. 2). On each side of the mouth occurs the neuropodial cirrus of the buccal segment, and at the base of this a bundle of capillary setæ. The second segment is distinct dorso-laterally, merging into the peristome below; it carries a bundle of neuropodial setæ, above and adjoining which there is a triangular lappet; farther up the side follows another triangular lappet and dorsally the first cirriform branchia (Plate VIII., fig. 1). The third, fourth, and fifth segments carry on each side a neuropodial fascicle of long, rather narrow spatulate setæ with laciniate tips ending in a point, and a laterally placed notopodial fascicle of similar setæ with a

wider spatulate portion, disposed in a single series; in both fascicles the spatulate setæ are accompanied by more slender limbate setæ; dorsally these segments carry stout cirriform branchiæ. Next follow the uncinigerous segments, as many as 50 in number, after which the recurved achætous caudal extremity terminates the body.

The first 20 to 30 uncinigerous segments carry dorsal branchiæ; all carry ventral fascicles of fine capillary setæ, and the first three are provided with ventral ligules adjoining the capillary fascicles; the capillary setæ carry projecting laciniate scales or minute thecæ, overlapping like the cups of a Sertularian Hydroid. Adjoining the mouth, between the latter and the neuropodial cirri or ligules of the buccal segment, there is a pair of fleshy labial processes, which Mr. WATSON identifies as tube-building organs (Plate VIII., fig. 2).*

It is possible that the Ceylon form may be varietally distinct from the Mozambique type, and should be known as *P. pennata*, var. *bicornis*.

FAMILY: TEREBELLIDÆ.

Leprea inversa, n. sp.—Plate VI., figs. 141 and 142; Plate VII., fig. 197.

Station V., off Chilaw, Gulf of Manaar; 11 fathoms. One specimen.

The body-length, exclusive of tentacular cirri, is from 30 to 40 millims.; width in front 2·5 millims. The segments are numerous and the body much contorted. The anus is surrounded by a funnel-shaped pygidium. The branchiæ are inserted without reference to particular segments, the third gill occurring high up on the dorsal surface over the third or fourth setigerous lobe, the second over the first setiger and the first gill in front. Between the first and second gill there is a papilla. The first gill occupies the most ventral position and is the smallest in size, not more than one-third of the bulk of the second gill, the latter having about one-half to two-thirds the bulk of the third. There are eight ventral thoracic scutes behind the tumid labium; the first shield following after the labium is deeply grooved transversely; the scutes end sharply in the region of the 8th and 9th uncinigerous tori. The uncinigerous tori and the capillary fascicles are continued to the posterior extremity of the body; from the 7th torus (11th segment) backwards the uncini are biserially disposed. The tentacular cirri are not deciduous; no eyes were observed. The capillary setæ of the anterior segments are very narrowly limbate, with a slight twist towards the apex, but quite simple; those from the middle and posterior segments are geniculate (Plate VI., figs. 141 and 142).

In the anterior region, behind the ventral scutes, the median ventral tract is depressed between the tori. In the posterior abdominal segments the uncini (Plate VII., fig. 197) are still biserial. The proportions of the branchiæ, the difference between the anterior and posterior capillary setæ and the number of ventral

* A note upon the nature of the structures which, in the Sabellariidæ, surround the mouth, appeared in the 'Journal of the Marine Biological Association' (Plymouth), New Series, vol. vii. (1904), p. 301.

scutes are the principal features which differentiate this species from *Leprea ehrenbergi* (GRUBE), MARENZELLER ('Südjapan. Ann.,' part ii., 1884, p. 5 of reprint).

Polymnia labiata, n. sp.—Plate VI., figs. 143 to 145.

Locality:—One specimen from the pearl banks, Gulf of Manaar; another from Aripu Reef. The former inhabited a membranous tube encrusted with coarse unequal sand-grains and calcareous fragments (including an entire small Naticoid shell); the latter has a large test-like tube encrusted with foreign particles, mostly very small and chiefly calcareous. It appears that the incrustation of the tube of Terebellids affords no trustworthy evidence of specific identity except in particular instances. The tube in question is nearly six inches long, with a diameter of half an inch. The abdominal region of the contained worm had undergone fragmentation, but the other specimen from the pearl banks is complete; length about 115 millims., width of thorax 7 millims., segments upwards of 120. The transition from the torigerous to the pinnigerous region is not very abrupt, the diameter of the body gradually decreases and the anterior pairs of pinnæ may be rather wide and set low in the integument, resembling the tori. The well-marked scuta ventralia end between the ninth and tenth pairs of tori, leaving six clear pairs of tori behind the scutigerous region. When the ventral wall of the thorax is much contracted there is an appearance of ill-defined scuta being continued to the posterior end of the thoracic (torigerous) region. The tori of the right and left sides are always widely separated, not approximating in the mid-ventral line.

The diagnostic characters by which this species is to be distinguished from its congeners (in the absence of information concerning colour) are afforded by the structure and proportions of the uncini. The uncinus consists of three principal parts, the hook, the shaft or neck, and the manubrium; the relative dimensions of these parts appear to be constant for the species. The uncini of *P. labiata* are noticeable on account of the length and slenderness of the neck; the basal angle of the manubrium, which lies deepest in the integument, is produced into a short gubernaculum resembling the "Muskelfortsatz" of the uncinus of *Pista* (v. MARENZELLER, 'Adriat. Ann.'). The denticulations of the uncinus offer no tangible distinction and present considerable variety both in number and dimensions. Generally the main hook is surmounted by a pair of smaller hooks of the second order, followed by another row of three denticulations of the third order (the middle tooth usually much longer than the lateral) occupying the vertex of the uncinus. Occasionally accessory denticles may be observed on the brow of the uncinus (Plate VI., figs. 144 and 145).

No *Polymnia* was described by GRUBE from the Philippines. One species, *P. congruens*, v. MARENZ., is known from South Japan, differing clearly from *P. labiata* in the shape of the uncini, and in the number of scuta ventralia. GRUBE's *Terebella sarsii* from the Philippines ('Ann. Semp.,' p. 223) has three pairs of arborescent gills but no lateral lobes, conforming to *Nicolea* in the latter respect.

The description was based upon a single indifferently preserved specimen. If confirmed it will probably form the type of a new genus or sub-genus intermediate between *Polymnia* and *Nicolea*.

The labium and lateral lobes of the third segment are of the same nature as the corresponding processes in *Loimia* (Plate VI., fig. 143).

Polymnia socialis, n. sp.—Plate VI., figs. 146 to 148.

Locality:—Narrow sand-encrusted tubes of a small Terebellid were adhering to the tubarium of *Phyllochætopterus ramosus*, trawled off Galle at Station XXXIX., 16 to 30 fathoms. One of the larger tubes measured about 50 millims. in length, 2 millims. in diameter. Three pairs of arborescent gills, the first (longest) extending forwards beyond the upper lip. Seventeen pairs of capillary fascicles, sixteen pairs of thoracic tori, uncini uniserial in the first six tori, biserial and opposite in the rest, uniserial again in the abdominal pinnules, which are supported by fine sustentacular setæ. Capillary setæ simple, narrowly limbate. The band of scuta ventralia is well set off from the surrounding parts, rounded in front, attenuate behind, ending as a whitish streak in the region of the 13th–14th tori, but continued behind this point as a colourless median streak into the anterior abdominal region; behind the 9th torus the band of scuta becomes paler, whitish.

The dorsal surface of the worm is smooth and convex, not showing segmental divisions in the region of the thorax. The first segment which forms the lower lip is long below and deeply cleft, the right half slightly overlapping the left (Plate VI., fig. 146). The lateral lobe of the second segment, seen in side view, appears as a sub-elliptical or semilunar, symmetrical free dermal fold. The uncini are remarkable for the number of denticulations on the vertex, which exceed the narrow limits suggested by von Marenzeller for the genus. The vertex of the uncinus, when seen from above, shows a rosette of twelve denticulations, and attentive examination shows that these are arranged in arcs across the vertex. The general formula for an uncinus of this species, according to Marenzeller's system of notation ('Adriat. Ann.,' iii., 1884, p. 163, or p. 13 of reprint) would be as follows:—1, 22, 333, 4444, 55555. The rosette which appears in vertical view is formed by the teeth of third, fourth and fifth orders (Plate VI., figs. 147 and 148).

The limbus of the capillary setæ is, at least in some of them, wider over a sub-terminal tract than more distally, spreading like a pair of narrow fins on either side of the seta. The terminal portion presents a very narrow obscurely striated border. This is merely the continuation of the limbus, and is not like the laciniate plumose structure of the terminal filament in *Amphitrite*. In some setæ from one of the specimens the terminal portion is marked off by a shallow constriction from the bulk of the shaft. This is not a constant feature however, and the setæ of the larger individual end normally in a simple point.

Length of fore-body without the tentacular cirri (which are present knotted

together and calling for no remark) 13 millims., width 2 millims., total length of body 20 millims.

Polymnia triplicata, n. sp.—Plate VI., figs. 149 to 152.

Locality :—Galle, 4th August, 1902. Several specimens.

This is another tribranchiate Terebellid of small size, with fragile body and highly deciduous tentacular cirri. Length of a specimen, incomplete behind, 35 millims. ; thorax barely wider than rest of body, 3 millims. in diameter, with 17 setigerous segments ; abdominal portion with 34 pinnigers. Another abdominal fragment had 80 segments.

The second, third, and fourth segments (the fourth being the first setigerous segment) carry lateral lobes of approximately equal size (Plate VI., fig. 149). The scuta ventralia are 14 in number, counting from the second segment ; they end sharply on the 13th setigerous segment, leaving four setigerous (thoracic) segments without ventral shields. The central portions of the scuta are slightly marked off from the anterior and posterior borders, but otherwise they are simple, not biannulate nor areolated.

The arrangement of the anterior thoracic segments seems to differ considerably from the condition observed in *P. labiata*. As shown on Plate VI., fig. 143, there is, in *P. labiata*, a large lower lip with free sinuous border, considered as belonging to the second segment (*i.e.*, the first branchiferous segment) and followed by another achætous segment (the second branchiferous segment) carrying prominent lateral lobes. In *P. triplicata* the lower lip is followed by two achætous segments carrying lateral lobes, and also bearing the first and second pairs of gills. It appears, therefore, that in *P. labiata* and in the species of *Loimia* the much larger lower lip is a product of the fused first and second segments, while in *P. triplicata* the first and second segments are distinct below, the former alone carrying the lower lip. In this and in other respects (number of scuta, &c.), the present form offers a striking analogy to *Lanice triloba* described by Fischli from Ternate,* and were it not for the existence of the generic distinction, which is not apparent at the surface, the two species would probably be ranged together.

The enumeration of the anterior segments and the nature of the prostomium of Terebellidæ are matters of some obscurity. On Plate VI., fig. 149, the thin half-collar which overhangs and protects the mouth like an epistome or upper lip is seen in side view ; at the back of it are the scars of insertion of the tentacular cirri, followed by a clear surface of a segment showing numerous eye-spots. Then follow the gills on the second, third, and fourth segments. The uncini are much smaller than in *P. labiata*, and usually only one denticulation of the third order is to be observed (Plate VI., figs. 151 and 152). The dorsal portion of the thoracic segments becomes biannular, commencing from the region of the eighth torus (Plate VI., fig. 149).

* H. Fischli, "Polychäten von Ternate," 'Abh. Senckenberg. Ges.,' xxv., 1900, p. 122.

The branchiæ (as in *Lanice triloba*, Fischli) show very clear-cut dichotomous ramifications, the main stem of each gill dividing near the base into two main branches. In the biserial tori the uncini of the two rows are alternate and opposite, (*i.e.*, base to base), those of the anterior row progressive, of the posterior row retrogressive. In *Lanice triloba*, the uncini of the biserial tori are inverted (*i.e.*, vertex to vertex), as in *Loimia*, though in structure they resemble the uncini of *Polymnia*.

Loimia annulifilis (Grube)—Plate VI., figs. 153 and 154.

Terebella annulifilis, Grube, 'Ann. Semp.,' 1878, p. 225.

Locality :—Galle shore, under stones. Eight specimens.

Tube encrusted with coarse, rather large shell and coralline fragments up to 8 millims. or 9 millims. in diameter. In most specimens the body-wall of the dorsal thoracic region has ruptured, and a coil of the gut is protruding. Diameter of thorax up to 9 millims. ; length of body about 150 millims. ; abdomen coiled ; more than 200 segments.

Uncini from the first torus, 5-dentate ; from the third torus, 5-dentate (Plate VI., fig. 153) ; from the sixth, 5-dentate, the fifth tooth becoming smaller and in some uncini obsolescent ; from the ninth torus, 4-dentate in both rows ; from the twelfth, 4-dentate ; from the sixteenth, 4-dentate ; from the twenty-seventh torus (which is borne upon the eleventh abdominal pinnule), 4-dentate. From these enumerations it follows that the uncini of the first six uniserial thoracic tori are 5-dentate, of the last ten biserial thoracic tori and of the uniserial abdominal pinnules 4-dentate. No such distinction is recorded by Grube among the five species of *Loimia* described by him from the Philippines. In some of the uncini from the anterior tori there seem to be indications of a sixth tooth, and in one uncinus from the first torus there are six distinct teeth.

The first pair of arborescent branchiæ greatly exceeds the second and third in size, quite overshadowing them. Seen with low magnification, they present a densely racemose or finely tufted appearance, due to the fact that the digitations arise in groups from the main stem and thicker branches, curving inwards like the half-closed fingers of a hand.

According to the accepted interpretation of the anterior complex of the Terebellidæ, the buccal segment is destitute of appendages and sense-organs (segmentum buccale nudum), but is produced ventrally into a large free labial fold, which closes the ventral opening of the horse-shoe-shaped collar or epistome formed by the prostomium surrounding the mouth above and in front. The hinder portion of the prostomium looks uncommonly like a cephalic segment and carries the tentacular cirri, which are ringed with purplish colour as in Grube's *Loimia annulifilis*. The buccal segment is the first body-segment, and is here practically non-existent above, though represented below by the prominent labium. The second body-segment is the first branchiferous

segment, well-marked dorsally, obsolete ventrally. The third body-segment or second branchiferous segment is evident above and below, and is produced outwardly into two ear-shaped lateral lobes, between which there is a narrow rim representing the ventral portion of the segment. Behind this follows ventrally the first ventral scute belonging to the fourth body-segment, which is at the same time the third gill-bearing segment and the first setigerous segment. The fifth body-segment is the first uncinigerous segment, and the uncini are arranged uniserially in the first six pairs of uncinigerous tori; the ten following tori carry uncini in two rows. The twentieth body-segment is the last thoracic segment. Then follows the abdominal region, which is destitute of capillary setæ, the uncini being borne in single file upon the abdominal pinnules. The first scutum differs from those which follow by its large size and corrugated surface. There succeed to this nine plain scuta ventralia, becoming narrower and longer behind. After this again the scuta become subdivided by transverse grooves, finally ceasing between the penultimate thoracic tori. The posterior subdivided scuta present a dark colour in the preserved material (Plate VI., fig. 154). There are 17 fascicles of capillary setæ, which have a fibrous internal structure, the fibres separating out when the seta is crushed or broken. Some of the setæ, however, which were presumably broken before death, show a clean fracture. It may be noted in conclusion, that in one specimen the scuta between the eighth and ninth uncinigerous tori are divided by a cross furrow.

Loimia crassifilis (Grube).

Locality :—East side of Cheval Paar.

One very small individual of 20 millims., including the tentacular cirri; the latter are banded as in *L. annulifilis*. There are ten clear scuta ventralia, after which these become quite obscure, but the tori remain separated by a wide decreasing median ventral tract to the end of the thorax. Uncini from the fourth torus 4-dentate, with an occasional rudimentary fifth tooth at the apex; from the biserial tori 4-dentate, the fourth tooth small; from the abdominal pinnules 5-dentate, namely, four clear teeth and a rudimentary apical tooth. The above corresponds with Grube's description ('Ann. Semp.,' p. 226), "uncini pectiniformes dentibus tororum 4," although his specimen was a very large one. The abdominal region is slender and even; the thoracic region tumid; about 67 segments.

Loimia medusa (Savigny)—Plate VI., figs. 155 to 159.

Savigny, 'Syst. des. Ann.,' p. 86 (quoted from Grube, 'Ann. Semp.,' p. 228).

(1.) Three specimens from Aripu Coral Reef, about 80 segments, width of thorax 10 millims.; total length nearly 90 millims., of which 30 millims. belong to the thorax; abdomen subcylindrical, varicose, simply flexed (not spirally coiled), narrower than thorax (Plate VI., fig. 155). Uncini from the first torus 6-dentate; from the third some 5-dentate, some 6-dentate; from the fifth 5-dentate; from the biserial tori and abdominal pinnules 4-dentate. There are five pairs of tori behind the scuta

ventralia. The last plain scutum corresponds with the seventh pair of tori ; the rest are subdivided, terminating after the eleventh tori. The subdivided scuta are dark-coloured. The three pairs of branchiæ are subequal.

(2.) Two more small worms which I assign to this species were taken from the South-west Cheval Paar. These also have five pairs of tori behind the scuta, but the junction of the undivided and subdivided (or anterior and posterior) scuta occurs at the level of the eighth tori, clearly so in one, approximately so in the other specimen. One has 52 segments with a length of 36 millims., the abdominal segments being closely compressed ; the other has about 64 segments with a length of 45 millims. Uncini from the first torus 6-dentate, from the third also 6-dentate ; from the fifth 5-dentate ; from the biserial tori and abdominal pinnules 4-dentate. Part of a tube is encrusted with small shell-fragments of various sizes.

(3.) There are two other well-preserved worms taken from the Aripu Coral Reef, which afford the peculiarity of an accessory or eighteenth pair of capillary fascicles. The uncinigerous tori which accompany these fascicles are narrower than the preceding, thus affording a graduated transition from the tori to the pinnules. This is particularly so in one of the specimens where the accessory tori are much narrower than in the other. The tubes constructed by these worms are encrusted with coarse sand-grains with a scanty admixture of calcareous fragments.

The scuta ventralia are much narrower than in the first or typical variety, an appearance which may be partly due to the state of protraction of the body and the method of preservation (Plate VI., fig. 156). On account of this fact, together with the difference of the tubes and the presence of eighteen pairs of capillary fascicles, I will call this variety *angustescutata*, in order to facilitate future reference. The uncini from the first torus are mostly 6-dentate (Plate VI., fig. 157), the sixth tooth frequently reduced and sometimes obsolete ; in the fourth torus the uncini are 5-dentate (Plate VI., fig. 158) ; from the biserial tori and abdominal pinnules, 4-dentate (Plate VI., fig. 159). The body of these worms resembles that of the typical form, though somewhat more slender ; 83 segments, length about 100 millims., abdomen varicose, width of thorax 8·5 millims. The lateral lobes of the anterior segments resemble the corresponding structures in *L. annulifilis* (*q. v.*).

Loimia montagui (GRUBE)—Plate VI., figs. 160 to 163.

> **Terebella montagui**, GRUBE, ‘Ann. Semp.,’ 1878, p. 224.
> **Loimia montagui**, MARENZELLER, ‘Südjapan. Ann.,’ ii., 1884, p. 205.
> Not **Terebella montagui**, QUATREFAGES, ‘Hist. Nat. Ann.,’ ii., 1865, p. 361.

A large number of cylindrical worm tubes are labelled “ No. 32, *Terebella*, Palk Bay.” Many of the tubes are in short lengths, the more complete measure upwards of 100 millims. (4 inches) in length, with a diameter of 9 millims. They are coated with a thick dense layer of fine mud presenting a smooth surface, the lips of the terminal orifices approximated, so that no sign of the contained worm appears externally. I found two worms only belonging to the tubes.

The body is narrowed anteriorly (in the region of the scuta ventralia) and attenuated behind; in the middle region it is inflated and somewhat varicose; segments about 100, length about 85 millims., width of thorax in front 4 millims., behind the scuta 5 millims. (Plate VI., fig. 160). Counting the composite sternite of the 2nd, 3rd, and 4th segments as the first scutum, there are eight clear scuta followed by a rather ill-defined ninth. After this there is no trace of further scuta, the median ventral tract separating the tori uncinigeri is wide and smooth, and the length of body between the successive tori gives the worm a remarkable appearance. In the first torus the uncini are mostly 6-dentate, the sixth tooth sometimes large, sometimes rudimentary, and many uncini in the same torus are 5-dentate (Plate VI., figs. 161 and 162). In the fourth torus not one 6-dentate uncinus was observed, only 5-dentate uncini with a sprinkling (about 5 per cent.) of 4-dentate uncini. In the biserial tori only 6-dentate uncini were found in both rows (Plate VI., fig. 163). An abdominal pinnule contained 7-dentate uncini, the seventh tooth usually small and occasionally obsolescent, but clear enough to characterise the region.

In ventral view (Plate VI., fig. 160) this worm presents distinguishing features depending upon the size and limited number of the scuta ventralia, the absence of subdivided scuta behind the main series, and upon the divarication of the meta-thoracic tori. In the character of the uncini the species corresponds closely with *Loimia montagui*, Gr., as described by Marenzeller ('Südjapan. Ann.,' 1884, ii., p. 9, reprint), who, however, does not describe a definite succession of uncini such as I have noted above, namely, the 6-dentate uncini of the first torus, followed by a reduced denticulation in the succeeding uniserial tori, and this again by an increased denticulation in the biserial tori and a further increase in the abdominal pinnules. It agrees with *L. montagui* again in the triangular shape of the lateral lobes of the third segment and in the presence of a whitish glandular tract on each side of the dorsal surface over the capillary fascicles, extending from the gill-region to the eighth setigerous segment, where it ends in a point.

Although von Marenzeller records eleven scuta ventralia for *Loimia montagui* from Japan, and Grube ten for the example described by him from the Philippines; the former author specially notes that the most sharply circumscribed scutes are those from the second to the eighth inclusive, which accords with the variety from Palk Bay. Neither Grube nor von Marenzeller refers to the tube, which, in the case of Terebellidæ, may or may not be a matter of importance. Nor is any information given as to the nature of the locality. Both of these points, in the present instance, have a special interest, bearing upon the identification.

Loimia variegata (Grube).

Terebella variegata, Ehrb., 'Monatsber. Ak. Berlin,' June, 1869, p. 30 of reprint; Grube, 1878, 'Ann. Semp.,' p. 227.

One specimen in a thin membranous tube encrusted with shell-fragments and

sand-grains was present in the same bottle with *Eupomatus heteroceros*, *Eunice antennata*, etc.; no locality being given: probably South-east Cheval Paar.

In the second of the above-quoted publications GRUBE makes the important correction that the uncini are not 4-dentate, as previously stated, but 5-dentate. This species resembles *L. medusa* in the number of scuta ventralia, and consequently in the occurrence of five pairs of tori behind the scuta. These posterior tori touch one another in the middle line in their respective segments.

The specimen in the preserved state has a nearly uniform pale flesh tint, only the branchiæ, which are matted together, showing up dark. There is no great contrast between the diameter of the thorax and that of the abdomen; the latter is sub-cylindrical, smooth, somewhat varicose. The total length is about 80 millims., and the number of segments about 60, the maximum width 7 millims., thus presenting a close numerical correspondence with GRUBE'S original type. The scuta ventralia are narrow as in the angustescutate variety of *L. medusa*. This species is said by GRUBE to differ in colour from *L. medusa*, but in the preserved state the chief characteristics are the nearly even diameter of the body, the uncini of the biserial tori and abdominal pinnules which are 5-dentate, to which may be added the pale flesh colour. The fifth denticulation at the vertex of the uncinus is small but distinct. The average width of the thorax (excluding the capillary fascicles) may be estimated at 6 millims., that of the abdomen at about 5 millims. At the same time, if it were not for the quinquedentate uncini, I should probably have placed the worm under *L. medusa*.

In the living condition more fundamental differences may come to light. The worm was closely invested by its tube. The preserved specimens of *L. medusa* have a dark neutral colour in marked contrast with the pale flesh colour of this worm. A second smaller specimen shows very clearly the quinquedentate uncini of the abdominal pinnules. In this case the abdominal region is more attenuated, and the scuta ventralia end rather sooner, so that there are six pairs of tori behind them.

Grymæa, MALMGREN, 1865.

Three pairs of acervi of filiform branchiæ.

Capillary fascicles commencing from the second segment (first branchiferous segment) and extending to the posterior abdominal region.

Tori uncinigeri commencing on the fourth (? or fifth) setigerous segment. Uncini avicular, uniserial.

MALMGREN says the tori commence on the fifth setigerous segment, but in a specimen of the type species, *Grymæa bairdi*, MALMGREN, collected off Norway by the Rev. Canon NORMAN, which I had the opportunity of examining at the British Museum some years ago, they commenced on the fourth setigerous segment.

Grymæa cespitosa, n. sp.—Plate VII., figs. 164 and 165.

One specimen, incomplete behind, was obtained, in 40 fathoms, south of Rameswaram Island, at Station LIV.

The fragment comprises twenty-two setigerous segments, total length about 30 millims.; width of thoracic region 3 to 4 millims.; thorax straight, porrect, abdominal region bent, with smooth, convex, turgid dorsum. The pharetræ setarum are high, upwards of 1 millim. in front, decreasing gradually backwards. The simple, narrowly limbate setæ issue in two principal bundles from between the oblique lips. The ventral portions of eleven segments from the second are flattened, forming broad ventral shields subdivided by transverse grooves. There are nine torigerous segments in the thoracic region, the posterior thoracic segments being nearly as long as broad. The thoracic tori graduate insensibly into the abdominal tori, which are sessile, not pinnuliform. The uncini have the form shown in Plate VII., fig. 165, and the general formula 1–22–3. In side view the three tiers of teeth show clearly.

The branchial filaments are numerous, forming dense coils. Those of the first acervus commence low down near the ventral surface. They break away easily from the body in groups. The tentacular cirri, plainly grooved on the lower side, are much stouter than the branchial filaments (Plate VII., fig. 164). The three branchiferous segments also carry capillary fascicles, the first uncinigerous torus occurring on the first post-branchial segment. The branchiæ arise from the anterior parts of the segments in front of the corresponding capillary fascicles.

Family: SABELLIDÆ.

Branchiomma acrophthalmos, Grube—Plate VII., figs. 166 and 167.

This is the oriental form of the well-known *B. vesiculosum.*

Locality:—East Cheval Paar, Gulf of Manaar.

Baron de St. Joseph has shown that the character of the limbate setæ of the European species varies at different ages, being spatulate in the young.

The Ceylon specimen is a fragment comprising 16 segments, 21 millims. long (including the gills), 3 millims. wide; 15 radioles* in each gill; gills banded about six times purple and whitish. Each radiole carries a subterminal eye, the two dorsal eyes being the largest. The definition of *Branchiomma* given by de St. Joseph (1894, 'Ann. Sci. Nat.,' xvii., p. 249) states "Soies dorsales d'une seule sorte au thorax." In the Ceylon specimen the dorsal fascicles of the thorax appear to contain, and in fact do contain, two distinct kinds of setæ, normal limbate to the number of eleven, and spatulate (Plate VII., fig. 166) to the number of nineteen. The thoracic tori are biserial, containing a row of avicular uncini and a row of cuspidate setæ.

Grube describes ('Ann. Semp.,' 1878, p. 258) the collar as trilobate, apparently overlooking the ventral incisure which divides the two acuminate ventral lobes. These are in close juxtaposition and give the appearance of the simple wide triangular lobe described by Grube. The dorsal portions of the collar show a characteristic form, the free border deeply emarginate externally and reflected round the base of the gill-supports (Plate VII., fig. 167). There are eight thoracic segments.

* See definition of this term on p. 308.

Branchiomma quadrioculatum, n. sp.—Plate VII., figs. 168 and 169.

Locality :—Aripu Coral Reef. One specimen, apparently incomplete behind, 48 segments.

Thorax 4·5 millims. long, 2 millims wide. Abdomen 13 millims. long. Eight thoracic segments. Gills 6 millims. long, banded with three or four purplish vittæ; 14 radioles in each. Collar with median incisura ventralis, a deep median dorsal notch and a still deeper submedian dorsal notch on each side. The four most dorsally placed gill-rays carry subterminal eyes, of which the dorsal pair are larger than the subdorsal pair (Plate VII., fig. 168). Seen from below, pressing the gills aside, laciniæ buccales are brought into view, including a flattened median tongue which rises up straight between and below the antennæ, and on either side of it an arcuate membranous fold. The buccal setæ are normal, capillary, limbate; thoracic setæ normal limbate and subspatulate; thoracic uncini biserial, an anterior row of cuspidate uncini * and a posterior row of avicular uncini (Plate VII., fig. 169). Abdominal setæ 15, limbate; abdominal uncini uniserial, avicular.

Hypsicomus phæotænia (Schmarda).

Sabella phæotænia, Schmarda, ii., 1861, p. 35.

Hypsicomus phæotænia, Marenzeller, 'Südjapan. Ann.,' ii., 1884, p. 16 of reprint, p. 212 of the 'Wiener Denkschr.'

Sabella pyrrhogaster, Grube, 'Ann. Semp.,' 1878, p. 250.

Localities :—Station V., off Chilaw, Gulf of Manaar, 11 fathoms, several specimens; and South-west Cheval Paar.

Marenzeller notes the resemblance between *Sabella pyrrhogaster* and *Hypsicomus phæotænia*, but adds that in the former only one kind of setæ was observed by Grube in the thoracic tori. According to Grube also the dorsal setigerous lobes of the thorax only contain paleæ, whereas in *phæotænia* there are a few lanceolate setæ in addition to the paleæ. The latter discrepancy is easily accounted for by the fact that the lanceolate setæ are frequently broken and hence cannot be observed. The former discrepancy with respect to the tori in which the armature is biserial and dimorphic in *phæotænia* and alleged to be uniserial and uniform in *pyrrhogaster*, is undoubtedly due to the circumstance that the row of cuspidate uncini was overlooked. Neither does Grube mention the branchial eyes, the pigment of which was perhaps dissolved out of his material. This species has also been described by Grube as *Sabella fuscotæniata* in 'P. Zool. Soc., London,' 1874, p. 328.

A small though complete specimen measures 25 millims. long without the branchiæ, which add another 8 millims. From the posterior end of the basal lamella to the anterior border of the interfilar membrane or web measures 3·5 millims. The eyes occur on each side of the distal portions of the gill-stems, 14 to 17 in number, not in pairs. The terminal filament of the gill-stem is long, somewhat flattened and tapering to a point.

* "Soies en pioche"; "Pickelborsten."

The macroscopic characters by which the species may be recognised are the occurrence of an arcuate oblique double row of modified setæ in the first segment and the rich dark-brown colour of the ventral shields of the abdominal region. The short collar still retains a band of violet below; it is entire, its dorsal border being slightly concave, while its ventral border is produced forwards to a median point. The cuspidate uncini which accompany the avicular uncini are called "Pickelborsten" by von Marenzeller.

Accompanying the typical individuals described above there is another specimen in which the whole collar is violet except at the anterior border. It is in a state of protraction, and the modified setæ of the first segment are disposed in a slightly undulating longitudinal ridge which stands out pale upon the violet background. This specimen further shows violet vittæ and scattered spots on the gills, but no eyes are to be found; the terminal filaments into which the cartilaginoid axes extend are exceptionally long. The apparent absence of eyes is remarkable. The brown colour of the abdominal scutes is missing; only the anterior abdominal region is preserved.

Dasychone cingulata, Grube—Plate VII., figs. 170 to 173.

Two specimens in bottle with *Loimia variegata*, *Eupomatus*, &c. [? Cheval Paar].

Total length 26 millims., gills 9 millims. to 10 millims., thorax 4 millims., width 3 millims.; about 60 segments. Eight thoracic segments with eight fascicles and seven tori, the capillary limbate setæ of the first fascicle not different from the others. In each gill 19 to 21 radioles, each provided with about 14 pairs of dorsal stylodes and eyes; radioles subarticulate; terminal filaments of moderate length. In a thoracic fascicle there are 36 limbate setæ (Plate VII., fig. 170), and in an abdominal fascicle about half that number; the setæ issue in two bundles, upper and lower, those of the latter are shorter and (especially in the abdominal region) have a pronounced curvature, a broader limbus and a shorter flagellum (terminal filiform portion). It may be explained that the term "radiole," as applied to a single shaft or rhachis of the gills, is used here in the sense in which it has been employed by Professor McIntosh. It corresponds to Grube's filum branchiale. The actual branchial filaments which are borne upon a rhachis are the pinnæ, to which Grube applies the term radioli. Grube and McIntosh, therefore, use the term "radiole" in different senses. Grube ('Ann. Semp.,' 1878, p. 259) describes the radioles (*sensu* McIntosh) as longearticulate, which corresponds with the Ceylon specimen, and he remarks further that there are about ten pinnæ (branchial filaments) to each joint; this is also in accord with my observations (Plate VII., fig. 172). In the Ceylon specimen the articulation of the radioles is faintly indicated and best seen under low magnification.

Dasychone, like *Phyllodoce*, occurs singly in collections, and nearly every tropical specimen has proved to be a distinct species. Grube says that in *Dasychone decora*, Sars, the number of radioles in each gill varies from 20 to 36. The uncini of

Dasychone are striated parallel to the curvatures and are somewhat characteristic for the species. There are long-shafted and short-shafted forms and others, as in *D. bairdi*, McInt. ("Challenger") and *D. picta*, McInt., of special form. Examples of long-shafted uncini are those of *D. wyvillei*, McInt., and *D. orientalis*, McInt.; short-shafted uncini are in *D. cingulata*, Grube, *D. japonica*, McInt., *D. nigro-maculata*, McInt., and *D. maculata*, Fischli ("Polychäten von Ternate," 'Abh. Senckenb. Ges.,' Band xxv., Frankfort, 1900, p. 125).

The radioles of the Ceylon specimen of *Dasychone cingulata* agree in arrangement and form of stylodes and eyes with the figures of *D. japonica*, McInt., and *D. maculata*, Fischli. The colour has vanished except for the minute dark pigment spots between the fascicles and the tori of the abdominal segments. The denticulations on the vertex of the uncinus occur in transverse rows (about three in a row) as in many of the Terebellacea; two appear above the main hook in side view (Plate VII., fig. 171).

Eurato porifera (Grube)—Plate VII., fig. 173.

> **Sabella porifera**, Grube, 'Ann. Semp.,' 1878, p. 252.
> **Eurato**, St. Joseph, 'Ann. Dinard,' part iii.; 'Ann. Sci. Nat.' (7 ser.), xvii., 1894, p. 249.

"Large Sabellid from centre of coral block, Muttuvaratu Paar; yellow-olive body, scarlet and yellow plumes." Total length about 90 millims., of which the gills occupy 30 millims. and the thorax 10 millims.; eight thoracic segments; width 8 millims.

The colour of the preserved specimen is sandy-yellow without any trace of pigment spots or markings. The only relief from the yellow ground colour is afforded by the characteristic spongy glandular tract which occurs on the anterior dorsal thoracic region. This has a brown colour and appears divided into right and left portions by the dorsal thoracic groove.

Limbate capillary setæ of different lengths throughout; uncini uniserial, avicular with multidenticulate (cross-hatched) vertex, not different from those figured by von Marenzeller for *Laonome japonica*.

Branchial stems in a single row, a few of them only occurring at a slightly deeper level than the rest, about 51 on each side. The length of the laciniæ tentaculares is about 7 millims.

The dorsal glandular tract by examination under a lens appears to consist of anterior and posterior portions, the former of a looser texture and thicker; but in the specimen under description both regions have the same brownish tint. Another smaller individual which accompanied the one described above shows the glandular area much more clearly. There is a posterior pale porous tract with a labyrinthine structure, the sulci running, in general, transversely; in front of this there are two dark-coloured convex porous cushions. In this specimen the general colour is duller and the gills rather olivaceous. In both cases the ventral fæcal groove bends up

between the ninth and tenth ventral shields and passes round to the dorsum obliquely between the eighth and ninth capillary fascicles (Plate VII., fig. 173). The total length of the smaller worm is about 70 millims., of which nearly 7 millims. go to the thorax, 20 millims. to the gills.

Eurato notata (GRUBE)—Plate VII., figs. 174 to 176.

Sabella notata, GRUBE, 'Ann. Semp.,' 1878, p. 256.

A small worm in a finely encrusted closely investing tube was associated with *Phyllochætopterus ramosa* from Galle. The worm could only be removed from its tube with difficulty and not without damage, the gills adhering closely to it and to each other. The gills, with about 12 radioles in each, are banded with purplish colour, but the bands are all obscure in the preserved state with the exception of the basal band formed of a row of elongate dense purple spots, one on each radiole placed immediately in front of the level at which the radioles pass into the basal membrane which supports them. This is the first feature to meet the observer on removing the animal from its tube. The next distinction is afforded by the presence of a pair of subtriangular or pear-shaped pigment aggregates on the dorsal side of the first segment above the capillary fascicle, the apex directed forwards; this no doubt corresponds with the C-shaped mark which GRUBE noticed on his specimen. A pigment patch occurs on each side of the succeeding segments between the groups of setæ and the uncini, *i.e.*, between the fascicles and the tori.

In this specimen the thoracic segments were abnormal, fewer than normal and fewer on one side than on the other. Similar variations have been described in several Sabellidæ by the Baron DE ST. JOSEPH. On the left side there are three thoracic tori, on the right side four. In side view of the uncini three rows of teeth are to be seen on the vertex (Plate VII., fig. 174). The capillary setæ are all limbate, some long-limbate, others short-limbate and some rather wide-limbate (Plate VII., fig. 175). The limbus of these setæ is a kind of guard upon one surface embracing the setæ. From some points of view the seta appears bilimbate, but when the shaft is broken across, the limbus may be left projecting far beyond the broken edge (Plate VII., fig. 176).

The total length of the worm is about 12·5 millims., of which 2·5 millims. belong to the gills; width 1 millim., length of tube nearly 20 millims. The collar of this species is only conspicuous ventrally, where it is represented by a pair of ventro-lateral lobes, broad lappets subacute in front at the outer angles; these are what GRUBE called the laciniæ ventrales. GRUBE'S was a larger example and the proportion of the length of gills to body-length differs from that of the Ceylon representative. Another fragment of a larger individual was obtained on east side of Cheval Paar, and also showed clearly 4 thoracic tori on the right side, 3 on the left. The marks on the pronotum are C-shaped, with the concavity directed forwards and inwards.

Sabellastarte indica, Sav.—Plate VII., fig. 177a.

Cf. Quatrefages, 1865, 'Hist. nat. des. Ann.,' ii., p. 432.

A specimen from the pearl banks, upwards of 40 millims. long (without the gills) by 7 millims. wide, inhabited a tube nearly twice its own length encrusted with sand. The deciduous branchial crown together with the tentacular laciniæ was present, but thrown off. Projecting beyond the collar are two collapsible buccal lobes, evidently protruded by fluid pressure from within. At the ventral sides of the thoracic tori purple streaks occur, and similar streaks occur towards the dorsal border of the tori. In the abdominal region these streaks are replaced by minute spots. The gills are banded. The thorax is composed of eight segments with seven pairs of tori; the setæ, of all the fascicles alike, are limbate capillaries.

Another specimen labelled "No. 80, *Sabella fusca*, Grube, orange-bodied *Sabella*, on under side of boulder, Galle lagoon, off Breffit, 7th June, 1902," is larger and darker; 100 millims. long (without the gills), 10 millims. wide; body subcylindrical in front, more flattened behind. Gills very dark; inner surface of collar with black-purple band and a patch of the same colour on the outer surface of the dorsal portions of the collar.* In frontal view of the buccal crown the two buccal lobes described above are seen, though not protruding to the same extent (Plate VII., fig. 177*a*).

Sabellastarte indica, var. **quinquevalens**, nov.—Plate VII., fig. 177.

Another specimen, brought up by the divers from Muttuvaratu Paar, inhabited a membranous tube coated with fine mud. Total length 100 millims., of which 35 millims. belong to the branchiæ; more than 140 segments. The thorax is composed of six segments with five pairs of uncinigerous tori. The uncini are uniserial and show numerous denticles above the main tooth, presenting, in frontal view, a finely cross-hatched appearance, in side view a series of 8–10 minute rows on the vertex of the hook (Plate VII., fig. 177). Width of the thorax 8·5 millims., of the anterior abdominal region 7 millims. Branchiæ banded with purple, the radioles or stipes in two rows, but the bases of all show through the basal membrane. The radioles of the two rows are roughly alternate, though the outer row contains more than the inner. Terminal filaments of gill-stipes short; gill-filaments biserial. Collar with broad purple submarginal band on inner surface, as in the typical examples. It seems likely that *S. indica* is co-specific with Grube's *S. spectabilis* ('Ann. Semp.,' p. 253) and even with Marenzeller's *Laonome japonica* ('Südjapan. Ann.,' ii., 1884, p. 16). See also St. Joseph, "Ann. de Dinard," 'Ann. Sci. Nat.,' xvii., 1894, p. 249. The number of thoracic segments is known to be subject to individual variations. The collar is notched below by a median incisura ventralis.

* Similar colour-markings occur on the collar of the first example.

Jasmineira caducibranchiata, n. sp.—Plate VII., figs. 178 and 179.

Locality :—East side of Cheval Paar.

A small slender worm of nearly even diameter, gently tapering behind, 22 millims. long, 1·5 millims. wide; eight thoracic segments, 36 abdominal segments with anal groove passing obliquely across the first abdominal (9th body-segment) to the right side and on to the dorsal surface. The thoracic segments do not differ macroscopically from the anterior abdominal segments; there are 8 dorsal capillary fascicles, and 7 ventral tori carrying a single row of rostrate uncini with long manubrium (Plate VII., fig. 178). The abdominal uncini are avicular (Plate VII., fig. 179). The buccal segment carries the first capillary fascicle near its hinder border and towards the dorsal side; the collar is rounded and slightly projecting forwards below, with a median notch or incisura dividing the two low rounded lobes, and a shallow impression on each side of the notch. On the dorsal side the collar stands out at right angles to the body and is then inflected at an acute angle, to be inserted on either side of the anal groove in this region. The gill-radioles are lost, but their carriers are retained and show the scars of about a dozen radioles each. Inside the gill-crown there is a pair of broad, pinkish-white laciniæ, and below these there is a group of about six slender tentacular cirri attached to the lower ends of the gill-carriers.

FAMILY: SERPULIDÆ.

Eupomatus albiceps, EHRB., GRUBE—Plate VII., figs. 180, 180A, and 181.

GRUBE, 'Monatsber. Berlin. Akad.,' 1869, p. 520 (p. 40 of reprint).

One specimen inhabiting a quadrilateral tube winding round a tube of *Phyllochætopterus ramosus* from Galle.

The worm only measured 7 millims. in length including the branchiæ, and a fraction of a millimetre in diameter. GRUBE's example was rather larger. The operculum gives the character of the species. In this case there are eight nearly erect, slightly curved virgulæ and a laterally compressed ovate lamina dorsalis, the latter being a direct continuation of the columella and bearing a pair of broad dorso-lateral chitinous hamuli. The marginal teeth of the opercular disc are blunt. Thoracic uncini, as stated by GRUBE, show about nine teeth.

Another specimen, growing upon the tube of a larger species from South-east Cheval Paar, has length of about 20 millims. by width of 1·5 millims. There are seven virgulæ on the operculum, and the lamina dorsalis is quite flattened except at the back (Plate VII., figs. 180 and 180A). The uncini from the last thoracic torus show seven teeth. The bayonet setæ of the first thoracic fascicle show two clear spines at the base of the terminal process (Plate VII., fig. 181).

Eupomatus exaltatus, MARENZ.—Plate VII., fig. 182.

VON MARENZELLER, 'Südjap. Ann.,' ii., 1884, p. 217.

Station V., off Chilaw, Gulf of Manaar, 11 fathoms; one specimen without tube.

Differs from *E. heteroceros* in the structure of the operculum, other characters being approximately the same. The branchiæ are rather short, the stems stout and close together in a digitate manner, about 16 stems in each gill; terminal filaments slender, flagelliform. Thoracic uncini with six teeth, some with five only. The opercular style is stout, slightly flattened; the margin of the opercular cup carries 23 denticulations; from the centre of the cup a stout columella rises carrying a circle of eight large hooks, of which the dorsal one is larger than the rest and somewhat scythe-shaped, with a long hook directed ventrally and mesially; the seven smaller hooks have curved extremities directed outwards and are destitute of accessory processes (Plate VII., fig. 182). The operculum is associated with the right gill; no rudiment could be found on the left side. The first fascicle contains besides a few simple capillary setæ a bundle of strong unequally bifid setæ, the terminal process long and acuminate, the subterminal process very short and obtuse; these are called bayonet setæ (von Marenzeller).

The Ceylon specimen varies from the type, in which there is a crown of nine hooks instead of eight, and the thoracic uncini show seven or eight denticulations. In spite of these differences, which are not outside a possible range of variation,* the character of the crown of hooks is so distinctive as to leave no doubt as to the identification, notwithstanding the fact that von Marenzeller unfortunately omitted to state explicitly that the hooks of the crown, except the dorsal hook, are directed outwards; this is left to be inferred, and it is an important inference, since it decides the species.

Eupomatus heteroceros, Grube.

Grube, 'Verh. zool.-bot. Ges. Wien,' 1868, p. 639, Taf. 7, fig. 8.

Locality:—Several specimens from South-west Cheval and East Cheval, 8 fathoms.

Tube round, except flattened surface of attachment, doubled upon itself, U-shaped, or slightly convoluted and faintly ridged; it shows coarse growth rings and is overgrown with Bryozoa and pearl-oyster byssus. Thoracic uncini sexdentate. The opercular disc carries a crown of seven hooks turned inwards, of which one is larger and plain, the others equal among themselves and each provided with a pair of accessory lateral hamuli, and an inwardly directed basal process. The lateral hamuli are inserted lower down the shafts of the coronal hooks than in Grube's figures, and the basal hamules appear less upturned. The latter can hardly be seen without bisecting the operculum. The bayonet setæ of the first fascicle have bicuspidate processes as figured by Grube. The uniserial thoracic uncini, not observed by Grube, show five and six teeth, rarely seven. The marginal denticulations of the opercular disc end in rounded spatulate expansions.

The collection contains many examples of this species. In one series of seven individuals from the South-west Cheval, 13th November, 1902, one specimen has eight hamuliferous hooks on the operculum, in addition to the great hook instead of

* Compare *E. albiceps*.

the typical six. Two others have seven such hooks in addition to the simple hook. Meristic variations affecting a specialised organ composed of a limited number of parts are of considerable interest, especially in view of the analogy presented by *Eupomatus exaltatus* in this respect. Compare also the thoracic segments of *Sabellastarte indica*. Examples from East Cheval show six, seven and eight hamuliferous hooks respectively, in addition to the main hook.

The collar-margin is plain ventrally, not projecting forwards between the gills. The anterior free flap of the collar (seen from below) can be distinguished by a transverse groove from the posterior portion of the buccal segment, and at the sides of this groove there is a pair of thoracic organs analogous to those observed in *Pomatostegus actinoceros*. The orifice is guarded by a small triangular papilla which occurs at the level of the incisura lateralis of the collar.

Eupomatus minax (Grube).

Locality :—South-west Cheval Paar.

Small involved round tubes showing coarse growth-rings; pearl-oyster byssus sometimes attached to the tube. The marginal spines of the opercular disc vary between 19 and 21. The columellar spines are more erect than in Grube's figure ('Ann. Semp.,' 1878, p. 269); the large dorsal spine is vertical and has a strong recurved hook and two lateral accessory hooks.

Pomatostegus actinoceros, Morch—Plate VIII., figs. 3 and 4.

Morch, Otto A. L., 'Revisio critica Serpulidarum,' Copenhagen, 1863, p. 400, plate xi., fig. 16; Grube, 'Ann. Semp.,' 1878, p. 271.

This is an extremely variable species in regard to the structure of the operculum, and on the other hand it is the exact Indo-Pacific counterpart of the Antillean species *Pomatostegus stellatus*, Abildgaard (see Ehlers, 'Florida-Anneliden,' 1887, p. 296).

This species and *Eupomatus heterocerus* are the most abundant Serpulids in Professor Herdman's collection, and they must play an important part in consolidating the pearl banks as well as serving as a base for the attachment of the pearl oysters. This is proved by the byssi which still cling to many of the calcareous tubes secreted by these worms. The tube is massive, coarsely rounded or trigonal, rugged and overgrown. Sometimes the tube is provided with a high laciniate keel. The branchiæ are spirally rolled and banded. Their appearance varies according to the preservation. The transverse striation sometimes indicated is due to contraction, which causes wrinkling of the strong cuticle which covers the outer surface of the gills. The radioles have an internal septate structure, but the superficial wrinkles are not related to it, and the surface may be quite smooth. In one specimen from the Muttuvaratu Paar, brought up by the divers, I counted 36 radioles in one of the gills. The thoracic uncini showed as many as twelve teeth in addition to the basal, transversely expanded,

scalprate process which VON MARENZELLER calls the "Meisselzahn." In the last thoracic torus the teeth of the uncini were not so numerous as in the preceding segments, not exceeding nine.

The collar is approximately as long as the rest of the thorax, entire below and at the sides, open above and continuous with the thoracic membrane on each side. The operculiferous style carries a broad wing-like membrane on each side which terminates above in a short free simple lobe. This membrane can embrace and protect the gills when retracted within the tube.

The disc of the operculum is covered with a chitinous cuticle and carries a long narrow columella arising excentrically near the dorsal side and furnished with circlets of spines at intervals (Plate VIII., fig. 4). The circlets of spines may be webbed or free. In the former case the chitinous membrane which they support projects beyond the spines and forms a stage or disc equal in diameter to the actual basal disc of the operculum. In the specimen before me the columella carries four stages above the opercular disc and two circlets of spines above the topmost stage. Another from the same locality shows two stages above the disc and three free circlets of spines above. A third has one stage above the disc and six circlets of free spines beyond. A fourth has three stages above the disc and two circlets beyond. A fifth has one stage above the disc, then two free circlets, then two more, narrower, stages followed by a terminal circlet. The abdominal setæ, as mentioned by GRUBE, have the apical portion slightly marked off. They closely resemble the abdominal setæ of *Omphalopoma langerhansii* figured by MARENZELLER ('Südjap. Ann.').

In another example taken from the Muttuvaratu Paar the opercular style retains a roseate flush in the preserved state. The tube has a low dorsal keel. The columella of the operculum carries two corneous stages over the disc, surmounted by five circlets of spines. The radioles of the gills are disposed in a simple spiral, about 27 in each gill; they are slender and the surface is smooth. Thoracic uncini from the sixth (last thoracic) torus show 7 to 9 teeth in addition to the scalprate process. A specimen from the South-west Cheval Paar shows three stages above the opercular disc followed by three circlets. Others were obtained from the East Cheval Paar in 8 fathoms.

The buccal setæ of this species are delicate, forming a small, frequently inconspicuous bundle of about a dozen setæ, among which may be found some slightly distinguished as bayonet setæ. On each side of the buccal segment, on its ventral aspect, there is a large orifice bounded by prominent lips (Plate VIII., fig. 3). The collar-margin projects forwards as a tongue between the gills ventrally as in *Spirobranchus cervicornis*.

An individual was taken off Panadure, Station XLV., 25 fathoms, measuring 20 millims. in side view from the free edge of the collar to the posterior extremity of the body; the collar and thorax 7 millims.; the operculum projects 7·5 millims. beyond the collar; width of thorax 4·5 millims. The brachysomatic condition of the

abdomen may be due to regeneration. Between the whorls of the operculum a small Annelid was found by Mr. Hornell (see *Haplosyllis spongicola*).

Protulopsis palliata, n. sp.—Plate VII., figs. 183 to 185.

Associated in the trawl with *Phyllochætopterus ramosus* from Galle, Station XXXIX., 16 to 30 fathoms.

A round, slightly curved calcareous tube, attenuated behind, widened in front. The body without the gills is 19 millims. long, 3 millims. maximum diameter. Gills with between 30 and 40 radioles on each side, rolled inwards in a single spiral turn; no operculum. Thorax consists of seven segments carrying seven pairs of capillary fascicles, but I do not find the uncini commencing before the fourth segment. The first fascicle contains numerous limbate capillary setæ of the usual form. In the fourth fascicle, in addition to the ordinary setæ, there is a group of salmacine setæ (Plate VII., fig. 183). There are about twelve of this kind of setæ in the fascicle, characterised by a short normally limbate tract followed by a clear striated border extending to the tip of the seta. The striated border is not limited by a refringent edge; the latter ceases suddenly at the upper end of the limbus. The uncini show about twenty equal denticulations; the last tooth at the base of the uncinus is followed by a long characteristic spur (Plate VII., fig. 184). The abdominal setæ occur to the number of five in a fascicle (Plate VII., fig. 185). The collar, in combination with the thoracic membrane, shows a remarkable development dorsally, where it is produced forwards on each side into a wide lappet, which is rolled upon itself and is probably able to follow the branchial spire to its termination; the ventral portion of the collar is marked off from the dorsal portion by an incisura lateralis, and its ventral border is slightly concave.

Serpula granulosa, Marenz.—Plate VII., figs. 186 and 186a.

Von Marenzeller, 'Südjapan. Ann.,' ii., 1884, p. 215 (p. 19 of reprint).

Locality: South-west Cheval Paar; several specimens.

Tube round, subcristate to cristate; fila branchialia (radioles) about 26 on each side*; operculum shallowly concave, with 46-52 rays which project as denticulations at the margin. The grooves which separate the rays do not all reach to the centre of the disc; they are the superficial indications of dissepiments which project vertically with a free inner border into the substance of the operculum (Plate VII., fig. 186a). Seven thoracic segments; modified setæ of the first segment unequally bifurcate; capillary setæ of the other thoracic segments simple, limbate; thoracic uncini 5-dentate. *Serpula granulosa* differs from *S. gervaisii*, Qfg., by its cristate tube and the shallow cup of the operculum. The degree of concavity can be varied, sometimes the disc is nearly flat, sometimes slightly convex, but it does not seem likely that it could be deepened to the extent which characterises *S. gervaisii*.†

* Von Marenzeller gives 35 for the type.

† *Cf.* Grube, 'Ann. Roth. Meer.' (Frauenfeld), 1868, p. 640.

In a typical example such as that figured on Plate VII., fig. 186, the total height of the tube in the region of the orifice is about 6 millims., of which the crest occupies 1 millim. The operculum is sometimes dextral, sometimes sinistral in position, and at the corresponding point on the other side, as noted by VON MARENZELLER, there is usually a rudimentary operculum. Minute tubercles are sparsely distributed on the concave opercular disc.

Serpula watsoni, n. sp.—Plate VII., fig. 187, and Plate VIII., fig. 6.

Locality:—Trincomalee, February, 1902.

I have much pleasure in dedicating this species to Mr. ARNOLD T. WATSON, whose drawing illustrates it (Plate VIII., fig. 6). It is characterised by the great length of the ampulla of the operculum, 3 millims., slightly exceeding the length of the style, the total length of the operculum being 5·5 millims. The ampulla is about twice the length of that portion of the style which rises above the collar. The disc of the ampulla is traversed by about 25 rays. There are about 30 radioles in each gill. The collar is entire below, divided on each side by an incisura lateralis. Uncini from the last thoracic torus with 5 and 6 teeth (Plate VII., fig. 187).

Spirobranchus cervicornis, n. sp.—Plate VII., figs. 188 to 192.

One specimen in bottle with *Loimia variegata*, *Dasychone cingulata*, &c. [? Cheval].

Total length 22 millims., made up as follows:—Gill-apparatus (including operculum) 7 millims., thorax 5 millims., abdomen 10 millims. Width of thorax 4·5 millims. The gills diverge outwards; the gill-rays (radioles) are rolled inwards at the top and are disposed in a spiral of one turn and a half, about 30 in each gill. The thorax consists of seven setigerous segments with six pairs of uncinigerous tori. The first segment is produced into a capacious collar open above, its dorsal ends overlapping and covering the expanded style of the operculum, nearly reaching to the disc (Plate VII., fig. 188). Ventrally the collar-membrane is produced forwards as a tongue-like process between the gills (Plate VII., fig. 189). The buccal setæ (of the first fascicle) are of two kinds, long, slender, capillary setæ fringed with hair-like striæ though without a definite limbus; towards the tips of the setæ the marginal hairs project; secondly, stouter bayonet setæ with pilose extremities (Plate VII., fig. 191). The remaining thoracic setæ are of the common limbate type and call for no remark; there are two groups of different sizes, more slender and stouter, in each fascicle. Thoracic uncini with fifteen teeth and a basal T-shaped mucro (Plate VII., fig. 192). The abdominal setæ are of the kind called "Dütenborsten" [geniculate setæ] by VON MARENZELLER ('Südjap. Ann.,' ii., Taf. iv., fig. 4*b*).

In *S. cervicornis* the horns of the operculum resemble a pair of antlers, of which the dorsal tine is half the length of the main tine (Plate VII., fig. 190). They only differ in proportion from the horns of *Spirobranchus giganteus* as figured by MORCH (1863) and EHLERS (1887).

It is not easy to define the limits of the genera *Pomatoceros*, PHILIPPI (1844) and *Spirobranchus*, BLAINVILLE (1818). GRUBE uses *Pomatoceros* in an extended sense and appears to disregard the prior claims of *Spirobranchus*; the latter is retained by EHLERS (1887) and ST. JOSEPH (1894). The genus *Pomatoceros* s. str. comprises the species *crucigera*, GRUBE (Red Sea, 1869), *helicoides*, MARENZELLER (Japan, 1884), *triqueter*, L. (Europe, MORCH, 1863, ST. JOSEPH, 1894), and *bucephalus*, MORCH (Philippines, 1863). GRUBE'S *Serpula quadricornis* ('Ann. Semp.,' p. 275) appears to me to be probably co-specific with MORCH'S *Spirobranchus semperi* ('Revisio Serpulidarum,' 1863, p. 405). The species of *Pomatoceros* named above practically resolve themselves into two main groups represented respectively by the European *P. triqueter* and the Oriental *P. bucephalus*.

Spirobranchus semperi, MORCH.

MORCH, 'Revisio Serpulidarum,' Copenhagen, 1863, p. 405.
Serpula quadricornis, GRUBE, 'Ann. Semp.,' 1878, p. 275.

Opercular style with wing-like expansions as in the preceding species, opercular disc flat, carrying four distinct horns. Uncini from the last thoracic torus with 12 to 13 teeth.

Spirobranchus semperi, var. **acroceros**, nov.—Plate VII., fig. 193.

This variety is represented by several specimens apparently only differing from the typical form in the fact that the opercular disc is cone-shaped, carrying the horns at the top (Plate VII., fig. 193). Length 12·5 millims. (up to nearly 20 millims.); about 50 abdominal segments; gill with 18 radioles.

Spirobranchus tricornigerus (GRUBE).

Serpula tricornigera, GRUBE, 'Ann. Semp.,' 1878, p. 273.

A small specimen from the pearl banks. The great feature of this species is the horizontal branching of the horns of the operculum, the main branches very slightly elevated and the ultimate ramifications lying approximately in one plane. The horns are very pale, calcareous, slightly chitinised. It is possible to distinguish three main branches proceeding from a common centre, but not so equilateral as in GRUBE'S figure. GRUBE assigns 20 teeth to the larger thoracic uncini. I only see the usual 12 teeth in the uncini of the last thoracic torus. The buccal setæ forming the first thoracic fascicle are of two kinds, simple capillary and bayonet setæ, both kinds with serrulate border. The gills are traversed by a strong, nearly black fascia a short distance in front of the basal membrane.

Vermilia pygidialis, n. sp.—Plate VII., figs. 194 to 196.

Locality:—South-west Cheval Paar.

Distinguished by the long, brown, horny, ringed, conoidal operculum, and by the obtuse posterior end of the body, which is furnished dorsally with an oval purplish-

crimson cushion and long hair-like setæ (Plate VII., figs. 194 and 196). Ten radioles in the left gill; nine and the operculum in the right. Uncini from last thoracic torus with eleven teeth and a scalprate process (Plate VII., fig. 195). Capillary setæ of first thoracic segment not distinguished from the rest; simple limbate, accompanied by slender non-limbate setæ. Mid-abdominal region with dorsal uncini and ventral fascicles containing three geniculate setæ. Total length of operculum 5 millims., the style 2·5 millims., the ampulla and columella 2·5 millims. Length of gills 4 millims., of thorax 4 millims., of abdomen 11·5 millims. The terminal filaments of the gill-radioles are clubbed; in one specimen the clubs have a pinkish colour (Plate VII., fig. 194). The closeness of the intersegmental grooves gives the pygidium a foliate appearance. The tube is coiled horizontally upon itself, widens out in front, and presents 4 or 5 low longitudinal keels.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. *Chlœia flava.* Dorsal barbed bayonet seta. Zeiss 3 C.
„ 2. „ Ventral furcate seta. Z. 3 C.
„ 3. *Hermione malleata.* Dorsal glochideal seta; the point is broken. Z. 3 C
„ 4. „ Ventral furcate seta showing accessory tooth. Z. 3 C.
„ 5. *Pontogenia indica.* Anterior end.
„ 6. *Iphione muricata.* Anterior end.
„ 7. *Lepidonotus carinulatus.* Prostomium.
„ 8. „ Carinulate papillæ of elytron arising from clear areoles.
„ 9. „ Echinulate papilla.
„ 10. „ Stellate papilla.
„ 11. „ Ventral seta. Z. 3 C.
„ 12. *Halosydna zeylanica.* Parapodium.
„ 13. „ Ventral seta. Z. 3 D.
„ 14. *Harmothoe dictyophora.* Elytron; the superficial filiform papillæ occurring on the larger shields are omitted.
„ 15. *Harmothoe dictyophora.* Head.
„ 16. „ Ventral seta. Z. 3 C.
„ 17. *Hololepidella commensalis.* Dorsal seta. Z. 3 C.
„ 18. „ Superior ventral seta. Z. 3 C.
„ 19. „ Inferior ventral seta. Z. 3 C.
„ 20. „ Head and proboscis.
„ 21. *Panthalis melanonotus.* Head and proboscis.
„ 22. „ Fifty-fourth parapodium. *a*, geniculate appendix; *b*, dorsal cirrus; *c*, silken threads (tomentose setæ); *d*, notopodium; *e*, notopodial acicula; *f*, neuropodium; *g*, neuropodial acicula; *h*, ventral cirrus; *i*, coil of threads inside the body.

Fig. 23. *Panthalis melanonotus.* Lateral processes of four successive segments after the 28th, showing dorsal cirri with geniculate appendices, alternating with elytrophores and ovate processes; seen from above.
„ 24. *Panthalis melanonotus.* Superior ventral seta.
„ 25. „ Penicillate seta.
„ 26. „ Aristate seta.
„ 27. „ Inferior ventral seta.
„ 28. *Panthalis nigromaculata.* Anterior end.
„ 29. „ Head.
„ 30. „ Jaws.
„ 31. „ Third elytron.
„ 32. „ Parapodium.
„ 33. *Psammolyce zeylanica.* Two of the dorsal dermal papillæ.
„ 34. „ Head and portion of the anterior segments.

PLATE II.

Fig. 35. *Psammolyce zeylanica.* Dorsal cirrus of third segment. Z. 3 a.*
„ 36. „ Compound seta from second segment. Z. 3 C.
„ 37. „ Shaft of compound seta from third segment. Z. 3 C.
„ 38. „ Seta from central fascicle of neuropodium.
„ 39. „ Inferior ventral seta.
„ 40. „ Appendices of bidentate setæ.
„ 41. „ Lower border of parapodium with ventral cirrus.
„ 42. „ An elytron.
„ 43. „ Seta from central fascicle of 16th foot with cusp on shaft.
„ 44. *Psammolyce rigida.* Seta from central fascicle of 16th foot with plain shaft.
„ 45. „ Dorsal cirrus of third segment. Z. 3 a.*
„ 46. „ An elytron.
„ 47. „ Compound seta from second segment. Z. 3 C.
„ 48. *Sthenelais zeylanica.* Parapodium:—*v.c.*, ventral cirrus with its associated stylodes; 1, 1, 1, superior dorsal setæ (numerous, forming a dense tuft); 2, 2, inferior dorsal setæ, slender, striated; 3, superior ventral seta; 4, seta of the central group; 5, inferior ventral seta.
„ 49. *Sthenolepis japonica.* Parapodium.
„ 50. *Thalenessa digitata.* Superior ventral seta; the upper end of the shaft is faintly fringed. Z. 3 D.
„ 51. „ One of the digitate fimbriæ of an elytron.
„ 52. „ Anterior end:—*e.*, first elytrophore; *p.*, palp; *x.*, semilunar process of the second foot arching over the prostomium. The porrect cirrophores carry no visible setæ.

PLATE III.

Fig. 53. *Thalenessa stylolepis.* Head.
„ 54. „ Parapodium showing the ctenidium on the medial surface of the elytrophore and the cirriform branchia below the elytron; the marginal fimbriæ of the latter are concealed in this preparation.
„ 55. *Thalenessa stylolepis.* Compound seta from the 60th segment. Z. 3 C.
„ 56. „ Marginal plumose fimbria of an elytron. Z. 3 A.

Fig. 57. *Anaitis zeylanica.* Seta in side view.
„ 58. „ Articular portion of seta from above. Z. 3 D.
„ 59. „ Prostomium.
„ 60. „ Dorsal phyllode.
„ 61. *Notophyllum laciniatum.* Head, as seen after removal of the anterior phyllodes.
„ 62. „ End of shaft of seta showing the articular fossa.
„ 63. *Phyllodoce dissotyla.* Head.
„ 64. „ Parapodium.
„ 65. „ Portion of seta. Z. 3 D.
„ 66. „ The two kinds of papillæ on the proboscis.
„ 67. *Phyllodoce foliosopapillata.* Head and proboscis.
„ 68. „ Parapodium.
„ 69. „ Seta. Z. 3 D.
„ 70. *Phyllodoce macrolepidota.* Parapodium.
„ 71. „ Seta. Z. 3 D.
„ 72. *Phyllodoce sancti-josephi.* Head.
„ 73. „ Seta. Z. 3 D.
„ 74. *Irma limicola.* Parapodium; the bundle of fine dorsal setæ proceeding from the cirrophore is seen crossing the basal portions of the superior ventral setæ. Z. 3 a.*
„ 75. *Irma limicola.* Average compound seta.
„ 76. „ Inferior ventral seta.
„ 77. *Typosyllis taprobanensis.* Seta from posterior region of larger specimen. Z. 3 D.
„ 78. „ Posterior seta of smaller specimen. Z. 3 D.
„ 79. *Haplosyllis spongicola.* Head.
„ 80. „ Pharyngeal orifice and tooth.

PLATE IV.

Fig. 81. *Autolytus orientalis.* Magnified about 11 times.
„ 82. „ Fore-gut removed from body.
„ 83. „ Palps, mouth and tentacular cirri from below.
„ 84. „ Seta. Z. 3 J. water imm.
„ 85. *Nereis unifasciata.* Outline of 8th parapodium of right side seen from behind.
„ 86. „ Similar outline of 31st parapodium.
„ 87. „ Heterogomph spinigerous seta from 8th foot. Z. 3 D.
„ 88. „ Hemigomph seta from 18th foot. Z. 3 D.
„ 89. *Ceratonereis falcaria.* Dorsal seta from 27th foot. Z. 3 D.
„ 90. *Ceratonereis pectinifera.* Outline of 8th foot of right side.
„ 91. „ Outline of 32nd foot.
„ 92. *Platynereis bengalensis.* Dorsal falcigerous seta of 44th foot. Z. 3 D.
„ 93. „ Superior ventral falcigerous seta of same foot. Z. 3 D.
„ 94. „ Acervus of paragnaths of group IV., and maxilla.
„ 95. *Diopatra amboinensis.* Jaws protruding, seen from below. 1, 1, mandibles or forcipate jaws; 2, 2, serræ or saws; 3, impar; 4, 4, arcs; 5, 5, laminæ ventrales; *b.s.*, buccal segment.
„ 96. *Diopatra amboinensis.* First parapodium. Only a few setæ are indicated.
„ 97. „ Simple bidentate setæ from first foot. Z. 3 D.
„ 98. *Onuphis basipicta.* First right foot. Z. 3 A.
„ 99. „ Compound seta of first foot. Z. 3 D.

Fig. 100. *Onuphis dibranchiata.* Acicular seta from first foot. Z. 3 D.
,, 101. *Onuphis holobranchiata.* Tube about natural size.
,, 102. *Eunice martensi.* Right 46th foot.
,, 103. ,, Compound seta from 168th foot.
,, 104. ,, Acicular seta from same foot.
,, 105. *Paramarphysa orientalis.* Compound seta from anterior region.
,, 106. *Aglaurides fulgida.* Head removed, showing submedian eyes in groups, two large lateral eyes and three occipital antennæ.

PLATE V.

Fig. 107. *Aglaurides fulgida.* Right set of upper jaw-pieces from the side.
,, 108. *Aracoda obscura.* A jaw-piece of the first pair (left side).
,, 109. ,, Jaw-piece of the second pair (left side); fracture at the point marked *.
,, 110. ,, Right set of jaw-pieces.
,, 111. ,, Anterior end.
,, 112. ,, Ventral seta. Z. 3 C.
,, 113. *Glycera lancadivæ.* Articular ends of shafts of compound setæ, of form A. Z. 3 D.
,, 114. ,, Portion of a seta of form B. Z. 3 D.
,, 115. ,, Parapodial ligules of form A. Z. 3 A.
,, 116. ,, Parapodial ligules of form B. Z. 3 A.
,, 117. *Polydora hornelli.* One of the modified acicular setæ of the fifth segment. Z. 3 D.
,, 118. *Notomastus zeylanicus.* Anterior end in left side view showing the half-retracted prostomium, the "tongue" below it, the first and second achætous segments, and the first setigerous segment.
,, 119. *Notomastus zeylanicus.* Unciniform or acicular seta. Z. 3 J. water imm.
,, 120. *Armandia lanceolata.* Anterior end from above; 1, tentaculum impar; 2, nuchal organ; 3, rostrum; 4, anterior portion of metapleural fold.
,, 121. *Polyophthalmus australis.* Anterior end from above showing pigment tracks and nuchal organs.
,, 122. *Nicomache truncata.* Anterior fragment from the left side. Actual length 47 millims.; width 5 millims.
,, 123. *Nicomache truncata.* Frontal view of head.
,, 124. *Ammochares orientalis.* Anterior end from below.
,, 125. ,, From above (dorso-lateral), showing three capillary fascicles in front of the first pair of tori.
,, 126. *Chætopterus appendiculatus.* Modified seta from 4th foot. Z. 3 C.
,, 127. *Phyllochætopterus herdmani.* Anterior end from above. First pair of spirally coiled tentacles are lost.
,, 128. *Phyllochætopterus herdmani.* Modified seta from 4th foot. Z. 3 C.
,, 129. ,, Modified seta from 3rd foot of an aberrant individual. Z. 3 C.
,, 130. ,, Plan of one of the branchial segments.
,, 131. ,, Spatulate seta from first parapodium. Z. 3 C.
,, 132. ,, Abdominal uncinus. Z. 3 D.
,, 133. *Phyllochætopterus ramosus.* Branching tube.
,, 134. ,, Modified seta from 4th foot in side view. Z. 3 A.
,, 135. ,, Modified seta from 4th foot of another specimen in back view. Z. 3 A.
,, 136. ,, Lower portion of an uncinus from a branchial segment.
,, 137. *Pectinaria panava.* Uncinus from a posterior torus.
,, 138. *Heterocirrus typhlops.* Anterior region from above.

PLATE VI.

Fig. 139. *Cirratulus cylindricus.* Anterior region from above.
" 140. " Head and mouth from below.
" 141. *Leprea inversa.* Capillary seta from second setiger.
" 142. " Geniculate seta from 45th setiger.
" 143. *Polymnia labiata.* Anterior end from below; the bases of the tentacular cirri are indicated in front of the labium (= 1st and 2nd segments); the lateral lobes of the 3rd segment project beyond.
" 144. *Polymnia labiata.* Thoracic uncinus in front view. Z. 3 D.
" 145. " Uncinus from 9th torus in side view. Z. 3 D.
" 146. *Polymnia socialis.* Anterior region from below; the epistome projects in front; tentacles omitted.
" 147. " Front view of a thoracic uncinus.
" 148. " Side view of thoracic uncinus. Z. 3 D.
" 149. *Polymnia triplicata.* Anterior region from the right side; *ep.*, epistome; *lab.*, labium.
" 150. " Epistome (*ep.*), labium (*lab.*), and mouth in frontal view.
" 151. " Uncinus in three-quarter view. Z. 3 D.
" 152. " Uncinus in side view. Z. 3 D.
" 153. *Loimia annulifilis.* Uncinus from third torus. Z. 3 D.
" 154. " Anterior region from below, tentacles omitted; in front is the epistome, then the labium, then the lateral lobes.
" 155. *Loimia medusa.* Anterior region from below.
" 156. " var. *angustescutata*, showing additional tori and capillary fascicles.
" 157. " Uncinus from first torus. Z. 3 D.
" 158. " Uncinus from fourth torus. Z. 3 D.
" 159. " Abdominal uncinus. Z. 3 D.
" 160. *Loimia montagui.* Anterior region from below.
" 161. " Quinquedentate uncinus from first torus. Z. 3 D.
" 162. " Sexdentate uncinus from first torus. Z. 3 D.
" 163. " Uncinus from 13th torus. Z. 3 D.

PLATE VII.

Fig. 164. *Grymæa cespitosa.* Anterior end from the right side. The small circles in the first branchial acervus are the scars of branchial filaments.
" 165. *Grymæa cespitosa.* Uncinus. Z. 3 D.
" 166. *Branchiomma acrophthalmos.* Spatulate seta from thorax.
" 167. " Anterior end from above. In front the gill-bases are shown on each side, the radioles being omitted.
" 168. *Branchiomma quadrioculatum.* Buccal segment and cephalic complex from below.
" 169. " Uncinus. Z. 3 D.
" 170. *Dasychone cingulata.* Average superior thoracic capillary seta. Z. 3 C.
" 171. " Thoracic uncinus. Z. 3 D.
" 172. " Portion of a gill-radiole showing stylodes and eyes and the bases of the gill-filaments.
" 173. *Eurato porifera.* Anterior thoracic region from above.

Fig. 174. *Eurato notata.* Thoracic uncinus. Z. 3 D.
,, 175. ,, Thoracic capillary, broadly limbate seta. Z. 3 D.
,, 176. ,, Thoracic capillary seta with the shaft broken and the limbus projecting.
,, 177. *Sabellastarte indica.* Thoracic uncinus. Z. 3 C.
,, 177*a*. ,, Frontal view of cephalic crown; *d*., dorsal side; *t*., antenna or tentacular lacinia.
,, 178. *Jasmineira caducibranchiata.* Thoracic rostrate uncinus. Z. 3 C.
,, 179. ,, Abdominal uncinus. Z. 3 D.
,, 180. *Eupomatus albiceps.* Operculum in side view.
,, 180*a*. ,, Dorsal view of operculum.
,, 181. ,, Bayonet seta from first thoracic fascicle.
,, 182. *Eupomatus exaltatus.* Oblique lateral view of operculum.
,, 183. *Protulopsis palliata.* Salmacine seta from fourth thoracic fascicle.
,, 184. ,, Base of uncinus.
,, 185. ,, Abdominal seta.
,, 186. *Serpula granulosa.* View of orifice of tube with operculum *in situ*.
,, 186*a*. ,, Operculum bisected.
,, 187 *Serpula watsoni.* Uncinus from last thoracic torus. Z. 3 D.
,, 188. *Spirobranchus cervicornis.* Cephalic crown in dorsal view; *c*., collar flap turned aside.
,, 189. ,, Cephalic crown obliquely from below.
,, 190. ,, One of the opercular horns in side view.
,, 191. ,, Bayonet seta from buccal segment.
,, 192. ,, Base of uncinus in side view and in frontal view.
,, 193. *Spirobranchus semperi*, var. *acroceros.* Operculum from below.
,, 194. *Vermilia pygidialis.* Anterior region from dorsal side.
,, 195. ,, Uncinus from last thoracic torus.
,, 196. ,, Posterior end.
,, 197. *Leprea inversa.* Posterior abdominal uncinus. Z. 3 J. water imm. From one of the last three or four segments.

PLATE VIII.

The figures on this plate were drawn by Mr. ARNOLD T. WATSON, to whom the identification of the "building organs" of *Pallasia pennata* is due.

Fig. 1. *Pallasia pennata.* Side view of anterior region. *t*., retracted tentacles; *b*, white portion of peristome; *c*, brown portion; *d*, brown with white zebra-like stripes. × 19. *a*, internal bristles crossing when head contracts.
,, 2. *Pallasia pennata.* Ventral view of anterior region; *b.o.*, building organ. × 19.
,, 3. *Pomatostegus actinoceros.* Ventral view; *op.c.*, opercular cavity; *x*., thoracic orifice. × 16.
,, 4. ,, Dorsal view. × 16.
,, 5. *Stylarioides parmatus.* Showing recurved abdomen; the fore-body is seen from below. × 17. *a*, uncini.
,, 6. *Serpula watsoni.* Operculum. × 18.

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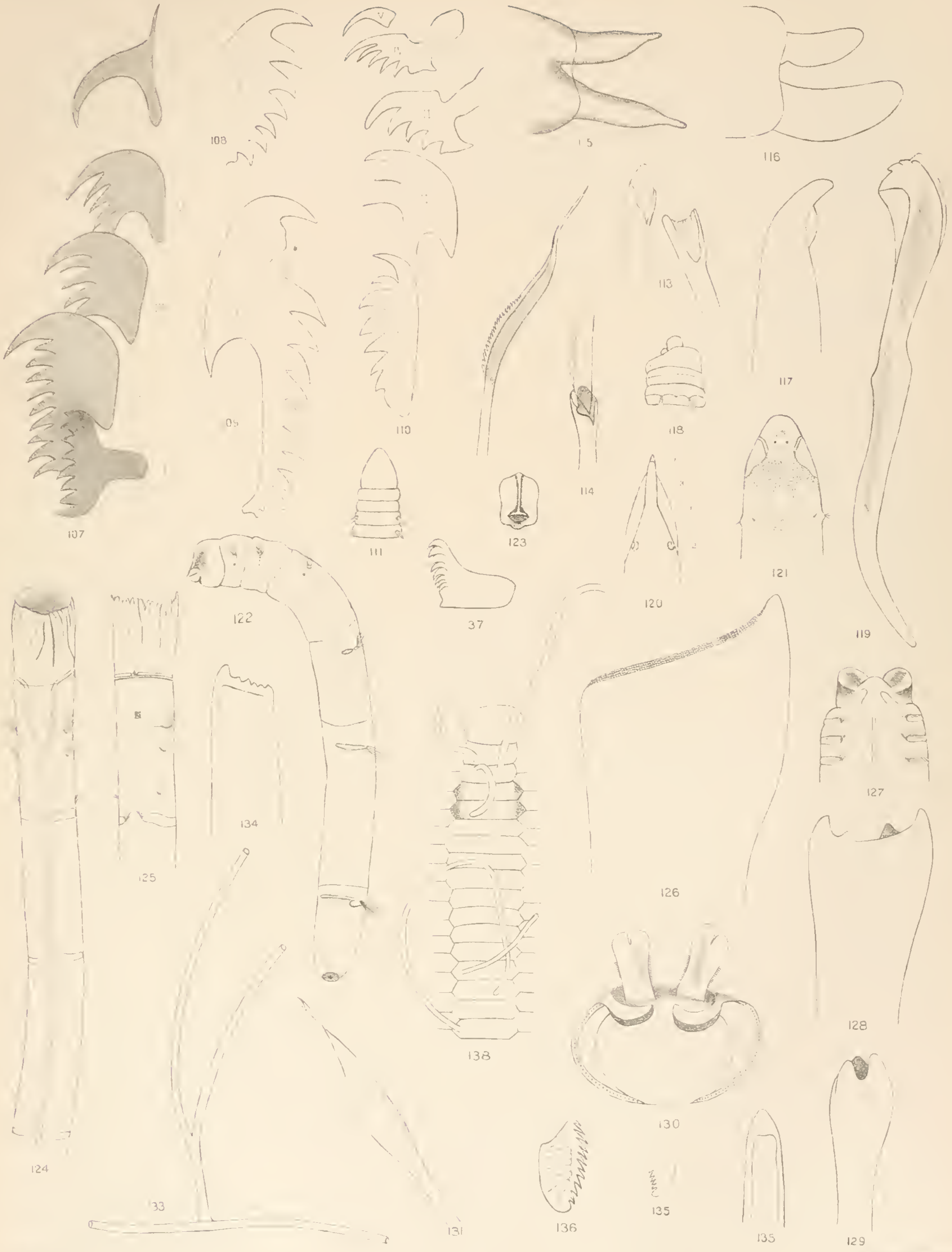
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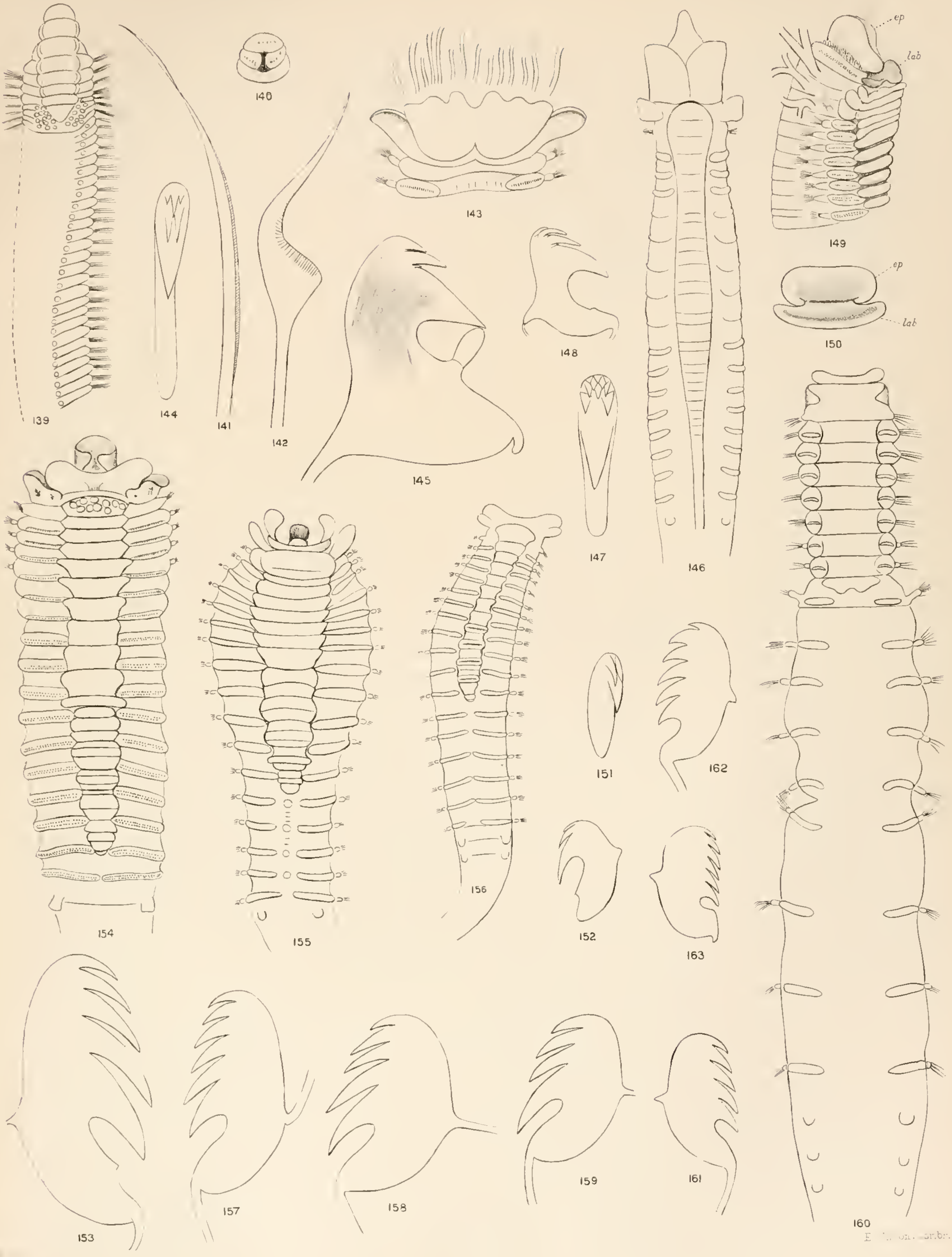
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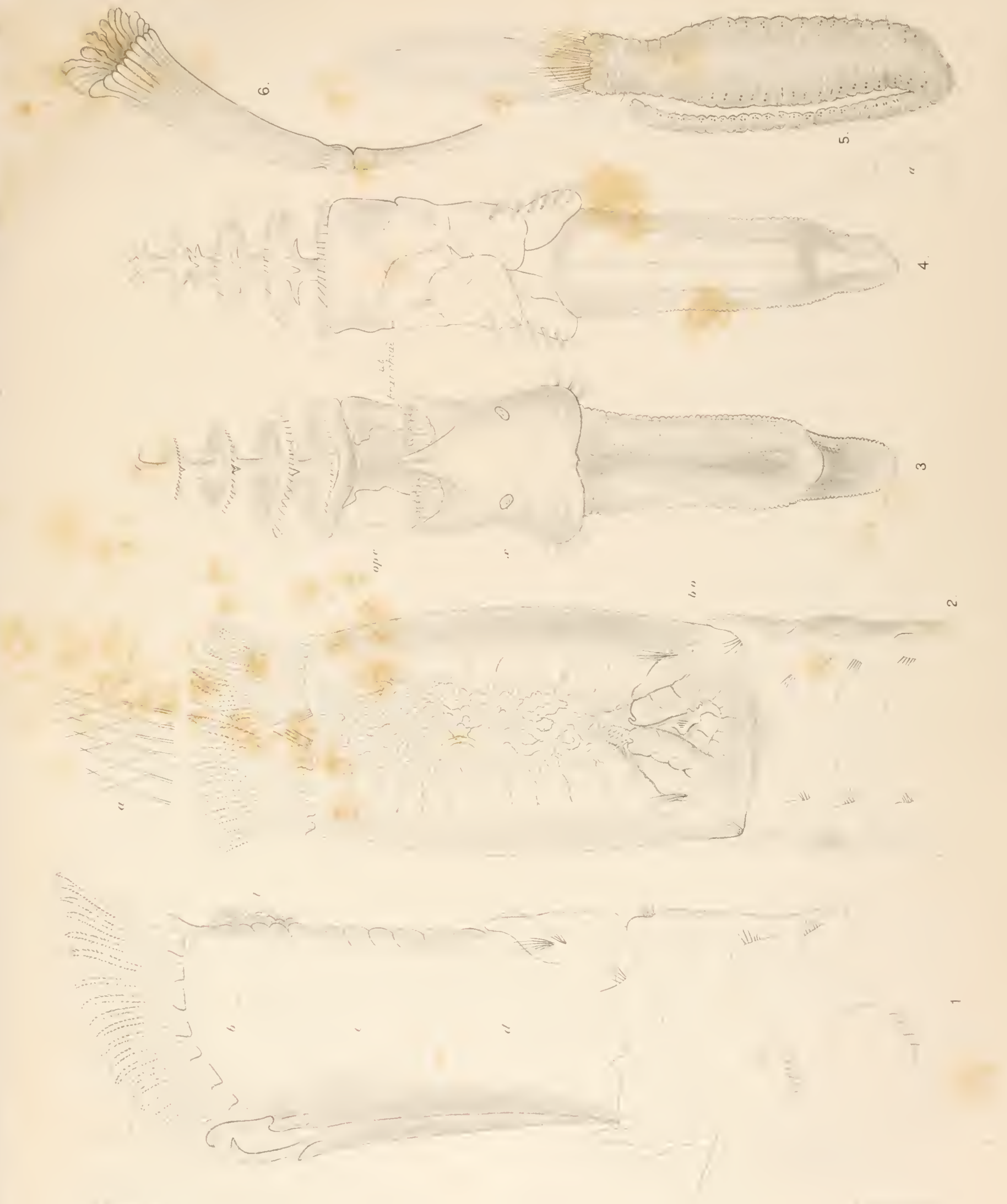


NOTE ON POLYDORA ARMATA, Lnghs.*

BY

ARNOLD T. WATSON, F.L.S.

THE specimens referred to in this note were found living commensally with a sponge, *Aulospongus tubulatus*, which is very common on the pearl banks, and is mentioned by Professor DENDY in his Report upon the Sponges in this series ('Ceylon Pearl Oyster Report,' Part III., p. 176).

A fuller description, with a figure showing the tubes piercing the sponge radially and the worms *in situ*, had previously been given by DENDY in his "Report on Sponges from the Gulf of Manaar" ('Ann. and Mag. Nat. Hist.' (6), iii., p. 73, 1889).

The general characteristics of the species are well described by MESNIL ('Bull. Sci. France et Belgique,' tome xxix., 1896, p. 203), and I have but few points of difference to note. Of these the most important, perhaps, relates to habitat.

The specimens described by MESNIL were obtained from *Lithothamnion*, through which they had pierced and in which they had formed tubes of calcareous sediment; while CARAZZI and LO BIANCO report these worms as living in the shells of VENUS and therein forming U-shaped tubes. A similar variation in habitat occurs in another closely allied species of this genus, *Polydora cœca*, which sometimes lives commensally with the sponge *Microciona plumosa*, as described by HORNELL ('Nature,' vol. 47, 1892, p. 78).

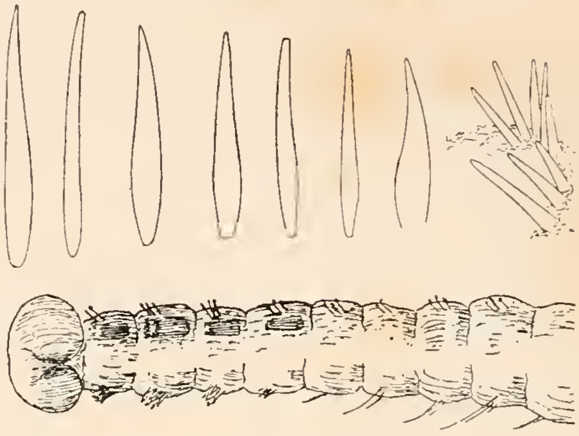
Owing to the difficulty of separating the worms uninjured from the sponge, it has only been possible to secure one or two fairly perfect specimens. The following notes, therefore, may be incomplete.

The Ceylon worm is apparently a smaller form of the species *Polydora armata*, LANGERHANS. The length varies from 2 to 3 millims. and the number of setigerous segments from 22 to 26. The branchiæ, of which I find four pairs, commence, as usual, on the 7th setigerous segment. They are comparatively broad and sometimes, but not always, of equal length. In one instance they gradually lengthen, the first being only half the length of the fourth. Eye-spots may or may not be present; most frequently they are invisible, but, after special treatment, in one case, I detected one pair. The tentacles are fairly long, reaching, in one specimen (though bent and twisted), to the 7th setigerous segment.

The setæ of the 5th segment, each with a characteristic hook, arising from an upright collar, which terminates on either side in a prominent pointed process projecting in the same direction as the hook (the whole having somewhat the appearance of an articulated seta), correspond well with MESNIL'S figure. They number two, or sometimes three, in each parapodium.

* LANGERHANS, 'Zeitschr. f. Wiss. Zool.,' 34, 1880, p. 93.

Each parapodium of the 7th and following segments bears two or three hooded ventral uncinigerous setæ. The general outline of the worm is noticeable. The caruncle is slightly bilobed in front and extends backwards to about the 2nd setigerous segment; the anterior ten or eleven segments (except the 5th) are nearly equal to one another in length and breadth; they are followed by seven or eight segments, which are much larger, being nearly double the length and breadth of the former; in the hinder part of the worm the proportions of the segments become somewhat similar to those at the anterior end. The anal segment is broader than the preanal (see fig. in text). It is somewhat reniform in outline, the indent being dorsal. The segmental divisions in the anterior part, although fairly clear, are not deep, but commencing with about the 13th setigerous segment the separation becomes more and more distinct, until the last four or five preanal segments, in which it is very marked. This marked separation is further accentuated by the presence in the parapodia of these last segments of a fascicle of from 15 to 18 stout brown setæ, which vary greatly in form, size and proportion, a fact which was not shown by MESNIL. The forms comprised are acicular, lanceolate and scimitar-like (see fig. in text).



Polydora armata, LNGHS.—Posterior part in dorsal view, × 75; part of a dorsal posterior fascicle; and seven dorsal setæ from a posterior fascicle, × 375.

These setæ, which are more numerous than in MESNIL's examples, have usually their points drawn together in preserved specimens, forming a hollow, subspiral, truncate cone; but in several cases I have found the fascicle opened out, the points of the setæ being widely directed outwards, an arrangement extending over three parts of a circle, the central convexity of which is directed antero-laterally. By dissection the fascicle can be unrolled, when the setæ of which it is composed are seen to be arranged symmetrically side by side, the longest in the centre and the smallest at the outer edges. Probably in life the fascicle is expanded with a sweeping action. The forms of the setæ seem admirably adapted to the function described, the swollen parts, some distance from the base of the seta, doubtless acting as fulcra and rendering mutual support and aid in the action I have suggested.

The distribution of the species as noted by MESNIL is: Atlantic Ocean (Madeira), Mediterranean (Naples), British Channel (Manche: "Anse St. Martin"), to which we now add the Gulf of Manaar.

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